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MECH ENGR CIV

RESEARCH ACTIVITIES AT THE SCHOOL OF ENGINEERING AND APPLIED SCIENCE

PUBLISHED BY THE ENGINEERS' COUNCIL IN COOPERATION WITH THE ENGINEER ALUMNI ASSOCIATION

Goodbye..... From the Editor's Desk....

Dear G.W. Engineers,

When looking back at my freshman year, I have to admit that I never thought I would have sentimental attachments to G.W.. But now, as a graduating senior, I have a lot of special memories of the people here, and the experiences we have shared. I appreciate how much I have grown personally during my years here at G.W..

It was sometime in the middle of my sophomore year that I realized I would only get out of my college career what I put into it. It was then that I became involved in a number of student organizations in the engineering school. One of the major tasks I took on, along with Lilimar Avelino, was Co-Editor in Chief of MECHELECIV.

I remembered when I first got a copy of MECHELECIV in the mail, I had no idea what it was. There was absolutely no way one could tell that it was a student magazine. That is why, as editors of MECHELECIV, we made it one of our major goals to produce a magazine for G.W. engineering students, by G.W. engineering students. We wanted to let students know what was going on in their school, as far as events, programs, research, etc. We also wanted it to be a medium by which undergraduates and graduates could share their projects and research. MECHELECIV should not just be another science and technology magazine, it has specific audience and a unique purpose. That purpose is to serve the engineering students and alumni of G.W.. We hope that our recent issues on the Career Center, the COOP program, and this issue featuring research at G.W., have brought us closer to this goal.

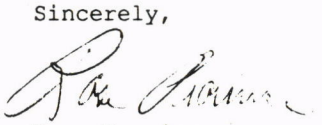
I would like to leave with a thank you to our hard working, dedicated staff, who survived deadlines and long hours of layout. I would especially like to thank our Associate Editor, Swati Patel. There were so many times when Lillie and I were stressed out and burdened with work, and Swati held everything together.

It was gratifying to see the Engineer's Council become more interested in MECHELECIV. I hope this trend continues.

Finally, I would like to introduce Nelson Kee as the next Editor in Chief of MECHELECIV. He is hardworking and motivated, and already has ideas that will allow MECHELECIV to grow and become a better publication.

Remember that MECHELECIV is YOUR magazine. Make it a vital part of life in the Engineering school!

Sincerely,



Rose Province
Co-Editor, MECHELECIV

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FOLEY: EE/CS CHAIRMAN DEPARTMENT'S RESEARCH.

Interviewed by
Lilimar Z. Avelino

"The Electrical Engineering and Computer Science Department at GWU stands for excellence - in teaching, in research, and in service."

THESE are the words of the newly-elected Chairman James D. Foley of the EE/CS department. MECHELECIV interviewed Dr. Foley to ask questions about the department's research activities, EE/CS program, EE/CS instruction, and aspects of student/faculty relations. The interview follows.

Q. When and how did you assume the chairmanship of the EE/CS department?
A. The chairmanship in this department is an elected position. The term of office is two years with the possibility of a second two years if the incumbent chairman wants to continue, and if the department is comfortable with the relationship that has developed. I was elected last March, and took office on July 1, 1988.

Q. What are your responsibilities and duties as chairman of the EE/CS department?
A. As the department chairman, 'the buck stops here' for all of our activities within the department. Naturally, I have much help from capable people to deal with various aspects of running the department. What I personally focus most of my energies on is how we can develop a stronger department - stronger in terms of research, the quality of our educational opportunities, and our organizational structures. So, I deal with finding research opportunities for our faculty, the quality of teaching, and organizational structure that will facilitate moving forward.

James D. Foley earned his Bachelor of Science in Electrical Engineering from Lehigh University in 1964. At the University of Michigan, he received his M.S. in Electrical Engineering in 1965, and his PhD in Computer, Information, and Control Engineering in 1969. He is a Professor and Chairman of the Electrical Engineering and Computer Science Department of the School of Engineering and Applied Science. His research interests are user-computer interfaces, computer graphics, and user interface software. Dr. Foley co-authored ***Fundamentals of Interactive Computer Graphics*** *with Dr. van Dam, and is currently revising it with Dr. van Dam, Dr. S. Feiner, and Dr. John Huges. He is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for contributions to computer graphics, and a member of the IEEE CG&A editorial board, the Association of Computing Machinery (ACM), the ACM Special Interest Group for Graphics (SIGGRAPH), the ACM Special Interest Group for Computer-Human Interaction (SIGCHI), Human Factors Society (HFS), and the American Association for Artificial Intelligence (AAAI). He is also the associate editor of ACM Transactions on Graphics and the International Journal of Man-Machine Studies.*

Q. When you assumed the chairmanship of the department in the beginning of July 1988,
***what goals did you set for the department,**
***how did you try to achieve those goals, and**
***at this point in time, have these goals been achieved?**
A. I said to the department in September that I was committed to helping the department achieve a common objective, that of continuing our growth in stature and capability in research, teaching, and service within the University and service to the larger local, national, and international technical community.

I, in fact, made a long list of things I wanted to try to accomplish while I was in office. Many of the easy things have been done, but they are not the most important things. The more important things are the mobilization of all of our energies to work toward our common objectives. Another is trying to develop a more organized environment. As an engineer, I like neatness and tidiness within an organization; however, there is also a place for informality to strike the right balance.

The department has tripled in size over the last twelve years. Because of the 'helter skelter' growth, we haven't always been able to keep pace with some of that growth. My number one personal goal, and it is a goal that has been echoed by a lot of the

EXPRESSES HIS VIEWS OF THE TEACHING, AND FUTURE

faculty members, is to see our department ranked in the ratings of electrical engineering and/or computer science departments in the future.

Q. What is the EE/CS department's greatest strength?
A. As in any organization, our greatest strength is the people who are involved in the department, i.e., the faculty members, the staff, and the students. Without those people, we would be nothing. With those people, we can be many things. We can only do so much with our own internal resources, and so we depend on external resources both from the university and from the research community to help achieve the objectives. One of the areas that we have been trying to further develop is having additional resources, so that we can leverage our people strengths. We really have some quite remarkable people in this department. It has been a real pleasure and very satisfying to work with these high quality people.

Q. What is the EE/CS department's greatest weakness? What is being done to strengthen this weakness?
A. Our greatest weakness is that we do not have the resources to be as good as we can be. What are we doing about that? We are trying to find additional external research support. We are trying to build more relationships with companies in the area. We, of course, look toward the engineering school and the University to help us in finding additional resources.

DEPARTMENTAL RESEARCH ACTIVITIES

Q. What role does research play in an educational/academic institution?
A. Higher education and research go hand-in-hand. It is difficult for faculty members to teach the state-of-the-art without their being involved in creating the state-of-the-art. Our objective, unlike some schools, is to maintain a balance between research and teaching. We do not want to see our research become the only focus of excellence. We think it is possible to create an environment where individual faculty members can develop as both excellent teachers and as excellent researchers. In this department we have some examples of individuals who serve as good teachers and as good researchers, for whom there is a positive feedback between these two roles. We are not so intent on developing our research reputation as to be willing to ignore students. There are departments where that is regretably the case.

Q. What research institutes are affiliated with the EE/CS department? Briefly describe the research efforts in these institutes.
A. We have a general institute, the Institute for Information Science and Technology, directed by Professor Walter Kahn. The charter encompasses all of the research areas of the department: telecommunications, signal processing, control theory, logic design, computer architecture, graphics and languages, artificial intelligence, and robotics. The second institute is more specialized: the Institute for Medical Imaging and Image Analysis. Professor Loew has developed it jointly with the medical school, working at the interface between image processing and electrical engineering.

In addition to the Institute for Medical Imaging and Image Analysis, which provides a focus for a particular group of research, we have a number of active research groups in the department:
1) the parallel processing research group, whose members are Professors Alexandridis, Youssef, Narahari, Choi, and Rotenstreich,
2) the educational software group, consisting of Professors R.S. Heller and Martin, and
3) the computer graphics and user interface group, consisting of Professors Sibert, Reuter, Senay, Schnizlein, and myself.

Q. The Institute for Information Science and Technology's Industrial Liaison Program (ILP) provides a cooperative bond between the EE/CS department and industry. Explain this program, and name some major companies who are involved in the ILP.
A. The major companies who are involved in the ILP are Melpar, Computer Sciences Corporation, and Contel. We become involved in a close working relationship with a company to share our research results and to try to understand the company's problems, so that we as researchers can see how our research might help the company. We try to share that understanding with the company. We have an annual research review day, which is April 10th this year. We invite members of the ILP companies to hear faculty members present their recent research work. It is a very effective way of reaching out to companies to build partnerships.

Q. The learning experience is much more meaningful when coupled with experimental demonstrations and research activities. With research, there is expansion of knowledge to ensure the future capabilities of engineering and technology. In brief, what are the current major research projects by faculty members of the EE/CS department?

A. (From handout on "Active Sponsored Projects", provided by Dr. Foley)

* Berkovich: GIT - Associative Pipeline Processor Simulation
* Della Torre: NSA - Micromagnetic Modeling for Recording;
NSF - Numerical Modeling for Magnetic Recording
* Foley: NSF - Undergraduate Computer Science Education Workshop;
IBM - Relationships in the Formal Specification of Interfaces;
NSF - User Interface Designer's Aide; NASA-USRA - Knowledge-Based Advisory System for General Scientific Data Visualization
* Foley (Sibert, Senay): Software Productivity Consortium - Knowledge-Based User Interface Design Tools
* Harrington: HMJ Corporation - Detailed Modeling of MHD Generators for Transient Stability Analysis
* Helgert: NASA-Goddard - Decoding and Performance Evaluation
* Hoffman: Census Bureau - Experiments in Reidentification;
Census Bureau - Risk Analysis of a File Matching Problem;
U.S. Secret Service - Vulnerability Analysis for Compounds and Structures
* Lang: University of Michigan - EOS Simultaneity Study - Radar Modeling and Data Analysis;
NASA-Goddard - Discrete Random Media Techniques for Microwave Modeling of Vegetated Terrain
* Loew: Food and Drug Administration - Algorithm Development for Tissue Characterization of Ultrasound Images
* Meltzer: GIT - Design of a Processing Element for an Associative Pipeline Processor
* Newman: U.S. Secret Service - Development of a Multipath Fading Simulator
* Pickholtz: E-Systems Melpar - Data Networks and Array Processing;
E-Systems Melpar - Simulation of Local Area Networks with Enhancement for Packet Radio
* Raff: APL John Hopkins University - Develop Event-Driven Montecarlo Simulation Program;
APL - Investigation of Laser-Induced Sound;
Mandex, Inc. - Program for Ice Thickness Measurement (Phase II)
* Reuter: G.W.U.-University Committee on Research - Visualization of Three-Dimensional Fractals Based on Iterated Function System
* Sibert: NASA-Goddard - An Intelligent Tool for User Interface Prototyping and User Interface Management
* Zaghloul: NSF - VLSI Implementation of Neural-Type Cells;
Ohio State University - Analog VLSI Implementation of Neural-Type Circuit

Q. Approximately what percentage of the EE/CS faculty are involved in research activities?

A. Nearly every faculty member does research at some time or another. Half of our current full-time faculty members have sponsored research, which means that they are paid by government agencies or companies to conduct research. Our younger faculty members are in the process of developing their ability to attract external research funding.

Q. How does a professor play the dual role of researcher and instructor? How is their academic instruction influenced by their research activities, and vice versa?

A. I would like to expand that question to also include how consulting activities, which a number of our faculty do, reinforce teaching and research and vice versa. If one is teaching a basic undergraduate course, research and consulting come in by way of examples of advanced applications. The ability to give examples of advanced research applications, even in a beginning level course, is a way of motivating, inspiring, and challenging students.

In the advanced seminar courses, we are basically presenting new research results: both our own and those from the community as a whole. To most effectively present contemporary research results, you need to be doing some of the research yourself, because that gives you the best understanding of how the different approaches relate, what the strengths and weaknesses are, and how the pieces fit together. It is much more difficult to do that from the outside looking at the set of research.

How does teaching help research? The same skills of explanation and analysis that one brings to the teaching process are important to the process of explaining research results and also the process of understanding where the research challenges and research opportunities are.

A number of our faculty members do consulting. Consulting is really a measure of the quality of the faculty, because after all, weak faculty members are not going to be asked by government or industry to consult. There are two points: 1) the fact that a number of our faculty do consulting is a positive indication of the quality, and 2) some of the issues on which the faculty members consult are at the state-of-the-art, and bring back either research challenges or specific applications for research ideas. In my own work I have seen a lot of examples of this, where unsolved problems that were raised as part of the consulting process led in very direct ways to research ideas, which in turn, have led to research grants. So, it all works together.

Q. In what ways, may undergraduate students participate in various kinds of research in the EE/CS department?

A. There are a number of possibilities. There is, of course, the undergraduate Honors Research Program. Just recently, I have made those of our faculty members who have National Science Foundation (NSF) grants, aware of the existence of an NSF undergraduate research program, whereby it is possible to get supplements to existing NSF grants to support undergraduates. I am planning on doing that, and I anticipate that my colleagues who have NSF grants will be doing the same thing.

It is always possible for undergraduates to become involved by approaching faculty members who are doing research, and volunteering to do some work. However, it takes some knowledge in the area. For instance, if someone came to me and wanted to do work in computer graphics, I would expect them to have taken the undergraduate graphics course first.

Q. Do you have any additional comments about research activities in the EE/CS department?
A. The interesting future development on the horizon is the Loudon County campus, which the University will open in 1991. The focus will be on industrial partnerships, research, and graduate education. That will represent a way for us to expand our interaction with industry.

EE/CS PROGRAMS

The EE/CS department offers several undergraduate and graduate degree programs. The undergraduate degree programs are computer engineering (as of this year), electrical engineering (with a choice of either straight EE or a medical engineering option), and computer science. The graduate degree programs lead to an M.S., Professional, and D.Sc. in electrical engineering (with concentrations in communications, electrophysics, energy conversion, power, and transmission, medical engineering, and system science, networks and controls), and computer science (with concentrations in hardware and systems, software and systems, artificial intelligence, and simulation).

Q. What does accreditation mean? Which EE/CS undergraduate and graduate programs are actually accredited?
A. For our department, there are two kinds of accreditation. The Engineering Accreditation Commission of the Accreditation Board of Engineering and Technology (ABET) accredits our engineering programs. As of this year, we have a computer engineering degree, replacing the computer engineering option in electrical engineering. Our electrical engineering and computer engineering undergraduate degrees are accredited by ABET. The computer science degree is accredited by the Computer Science Accreditation Commission of the Computer Science Accreditation Board (CSAB).

What accrediation means is that a group of peers from other universities spend several days in the department studying our undergraduate curriculum, advising system, labs, facilities, and the library to determine whether they meet the national standards set by either ABET or CSAB. We have been pleased that we have been able to meet those standards, with the support of the administration. All good engineering schools are accredited by ABET. The CSAB program is relatively new. We were very honored to have received accreditation during the second year of that program, and at this point, to be one of just under 100 schools that have received CSAB accreditation.

Graduate programs are not accredited as such. The university as a whole is accredited by the Mid-Atlantic States Accrediting Commission. This involves a look at the entire university, and a stamp of approval that the entire university meets the standards.

Q. Has the EE/CS department ever evaluated the amount of time students take in some of their EE/CS courses? If not, why not? For example, several one-credit courses seem like a full-time job, and take more time than their credit is worth.
A. Lab courses which are one-credit are really intended for skill development, as opposed to intellect development. We don't feel that we can justify the same amount of credit for a lab as for a course. We recognize that many labs involve a lot of work. We recently increased the number of credits for the senior labs from one to two credits, in recognition of the massive amounts of energies that students are investing.

Q. What new EE/CS programs should students look forward to in the future? For example, next semester, computer engineering will be offerred for undergraduate degree.
A. We have no current plans for additional options or degree programs. With the approval of the computer engineering undergraduate degree and with the medical engineering option, we really cover quite a broad spectrum. We are one of the few departments in the country to cover electrical engineering, computer engineering, and computer science. This is a very valuable relationship, because there are clear relationships between the three subdisciplines. Students in the department benefit, because our courses have been designed to cover all these areas in an integrated way. Students in other universities may find a less well-integrated set of course offerings.

Q. Assess the quality and quantity of computer facilities at GWU.
A. Computer facilities at GW are better than they could be, but not as good as they need to be. Our major weakness is in the engineering work stations. The Macintosh lab is large enough. I don't see it getting overly crowded very often, except at the end of the semester, when students who have put things off

too long all of a sudden realize that the 'day of reckoning' has come. I don't have a whole lot of sympathy. It would not be justifiable to buy extra equipment just to satisfy one week a semester caused by tardiness.

The School has just recently received a grant from Hewlett-Packard for $1.5 million of new equipment, which will arrive this summer. Then, our facilities will be among the best in the country.

Q. Do you have any additional comments about EE/CS programs or courses of instruction?
A. We keep working on updating our courses. As the faculty has expanded, we have been able to offer quite a variety of courses. No year goes by without changes in our graduate and undergraduate courses, as we look to always have the most excellent possible eduational opportunity for you and your colleagues.

EE/CS TEACHING AND INSTRUCTION

Q. What is your definition of a 'good teacher'? In other words, if you were a member of a 'Teacher of the Year' Award committee, what qualities would you look for in a teacher or instructor in order to make a proper selection?

A. I think that the most important characteristic of a good teacher is effectiveness in conveying information, in helping the students understand the subject material, in relating it to other things they know about, and in making students want to learn the material. Part of teaching is not just presenting facts, it is also presenting facts in ways that are memorable. For instance, standing up on a table is a wonderful way of making a particular point stand out.

In addition, while it is preferable that a professor be liked, it is much more important that a professor be respected. Another aspect is setting high expectations and high standards, and expecting students to meet those - pushing, challenging, and demanding.

Q. In a general overview, assess the quality of faculty members as teachers in the EE/CS department.
A. On the average, we have a collection of very capable teachers. Some individuals are better teachers than other teachers. I am very concerned about teachers who are perceived by students as not being effective, and try to work with (either directly or via my assistants) individuals who might benefit from some discussion about teaching methodologies or approaches.

Q. How are faculty chosen to teach courses for the following semester? Are their qualifications checked?
A. Full-time faculty members choose courses that they want to teach based on their interests. We would not expect a full-time faculty member to select a course that he or she is not able to teach. Not all of our courses are taught by full-time faculty members, so we depend on part-time faculty members and in some cases, graduate students. There, we work with our course director supervisors to chat with prospective part-time faculty members or prospective GTAs to make sure that they have the requisite background. Sometimes that does not work 100%. When it doesn't work, we try to fix it.

Q. Students complain about the incompetency, unavailability, etc. of some graduate teaching assistants (GTAs). In your opinion, is there really a problem? If so, what are you doing to improve their quality of instruction?
A. We have had, in specific cases, difficulties with quality of instruction. Sometimes our GTAs do not meet our expectations. Sometimes our part-time faculty members do not meet our expectations. Sometimes our full-time faculty members do not meet our expectations.

What do we do about it? Our two assistants to the chair, Professor Alexandridis and Professor Carroll, have as their primary responsibility working with our GTAs. We recently increased many GTA stipends, and there will be a small additional increase next year.

We have increased the percentage of courses that are taught by full-time faculty members, by hiring more faculty members. For instance, four or five years ago, barely 50% of our undergraduate courses were taught by full-time faculty members. Now, it is 70%. So, we have increased by 20% the number of courses taught by full-time faculty members. We would like to have that percentage be 80%.

We think it is valuable to have good part-time faculty members and good senior graduate students helping in the instructional process. Part-time faculty members bring expertise and pragmatic knowledge in areas that expand our course offerings, and are often highly rated teachers. Experienced graduate students can also do a fine job at teaching, because they can relate more directly to the undergraduates than the more senior faculty members.

Q. Do you have any additional comments on EE/CS teaching and instruction?
A. I have begun to use the Eta Kappa Nu survey of EE/CS instructors as one of a number of ingredients in my annual merit-pay recommendations, as a sign of the department's commitment to the importance of teaching. This puts an additional responsibility on students to give thoughtful answers to the survey questions, going beyond the potential superficiality of 'is this guy making me work too hard'. Students have to be serious about how they respond to the survey questions, and give thoughtful responses.

STUDENT/FACULTY RELATIONS

Q. What are the different student organizations doing for

the department?
A. Eta Kappa Nu, the Electrical Engineering and Computer Engineering Honor Society, provides a very valuable service for the department in conducting their survey, in recognizing achievement amongst our undergraduate students, and in awarding the 'Teacher of the Year' Awards to a Full-Time faculty member, a Part-Time faculty member, and a Graduate Teaching Assistant. IEEE provides a vehicle for exposure to professional opportunities for developing understanding of professional responsibilities. These are really the two major groups that interact directly with the department.

Q. Every entering undergraduate student is assigned a faculty advisor to assist in orientation in the professional discipline. Faculty advisors counsel students on their programs of study, achievement and maintenance of satisfactory scholastic performance, professional development, and extracurricular activity as part of the educational process. An approval of programs of study prior to registration is obtained from a student's advisor; however, some students complain that their advisor just signs a student's course sheet without looking at the EE/CS course, or checking whether the student has taken the appropriate prerequisites. Some faculty are not good advisors and should not be advisors; while others are excellent advisors, therefore having numerous students under them. What is your opinion of faculty/student advising? How can advising be improved such that only faculty, who are good advisors, do the advising?
A. Frankly, the quality of advising in this department is uneven. Not every faculty member takes this responsibility sufficiently seriously. Far too many students abuse the advising system by not seeking out their advisor until the last day, coming in and scurrying around, finding out that their advisor is not there, and trying to find someone else. All of our faculty members have posted office hours, and will make appointments to meet with their advisees. It is easier to find some faculty members and make appointments with them than it is to find some other faculty members; however, it is appropriate for students to make appointments to see their faculty advisors.

Q. If a student has a valid complaint about an EE/CS instructor or EE/CS course, what steps should he or she take? What does the EE/CS department do about the complaints?
A. The first step is to put something in writing, and to then bring it to the chairman's office. It is much more effective to have a student write out their concerns. The writing really forces a focussing of the key issues.

If the concern has to do with a graduate teaching assistant, then I ask Professor Carroll or Professor Alexandridis to become familiar with the situation, and if necessary, to meet with the GTA. If the matter concerns a part-time or full-time faculty member, then I, as chairman, try to develop an understanding of what the key issues are. I sometimes ask Professor Alexandridis or Professor Carroll to do some backfinding for me first. I sometimes meet with the student and/or faculty member either jointly or separately based on what seems most appropriate in the situation.

I am eager to hear legitimate student concerns. I wish there were none, but this is not a perfect world. There are always things in any organization that do not work right, and part of my commitment is to do what I can to make things work right. But the number of substantial concerns of this type are gratifyingly low.

A LOOK AT THE FUTURE OF THE EE/CS DEPARTMENT

Q. What are the EE/CS department's future plans?
A. The departmental retreat, which we held in October under the leadership of Professor Murray Loew, gave us an opportunity to focus on things we must do to achieve our goals of excellence in research, teaching, and service. A major need is identifying additional resources. There are some potential restructurings within the department that would provide additional resources. We could consider larger classes, but there are tradeoffs. One of the things that is unique here at GW is our relatively small class size. Last academic year, our average class size was in the low 20s, which is a contrast to the average class size one finds in many public institutions. We will also continue to emphasize finding funds from research sponsors, industry, and through other community fund-raising efforts.

Q. It is the year 2000, describe what you see in the EE/CS department, in terms of the EE/CS courses of instruction, the quality of faculty, and the kinds of students.
A. The first thing I see is a recognition that GW historically has been a stronger institution that many people have recognized. Even today, this department deserves to be ranked among the top 50 departments in the country, but for whatever reasons, has not had that recognition. The first thing that we will notice about the year 2000 is that we will have that recognition.

There will be a somewhat larger faculty, probably not twice as large as we are now. Our real objective is to get better, and not necessarily bigger. We have grown a lot in the last twelve years, and our technical education has developed very strongly. We really want to focus on quality, not quantity, and do a better job in teaching and research than we do now. We do a respectable job. We want to do a more than respectable job. We will also have a larger portion of our faculty members involved in sponsored research.

We will have an even stronger set of students than we have now. We will probably have at the graduate level a slightly different balance of full-time and part-time students than we have now. Right now, at the graduate level, we have about 1100 students, of whom 225 are full time. There will be a shifting of that to where perhaps one-third to one-half of our graduate students are full-time. At the undergraduate level, only about one-sixth of our students are part-time, and I expect that we will maintain that balance. I see more interaction with industry both at the graduate and undergraduate level. I see. more of the coop sort of activity at the undergraduate level, and some of that at the graduate level as well. The opportunities are there, but we have not developed that yet.

In terms of the instructional process, I think we will see computers used in virtually every course, either because the computer is an object of study or because the computer is being used to augment the subject matter. If one is studying circuits, then simulating circuits. If one is studying control systems, then simulating control systems. There may be a bit of self-paced instruction, but I don't see a lot of that. The basic mechanism in delivering instruction is the faculty members standing in front of classes and talking to students.

Q. Do you have any concluding statements?

A. In my new role as chairman, I have had my share of pleasures and frustrations. One of the real pleasures I have had is working with faculty, colleagues and students in what I know is our mutual commitment to continue to strengthen our department.

I want to extend my gratitude to Chairman James D. Foley for taking the time to grant me an interview. MECHELECIV wishes him much success in his new role as Chairman of the EE/CS department.

PICKHOLTZ: NEW COMMUNICATIONS TECHNOLOGY OPENS DOORS TO 21ST CENTURY

by Kavita Patel and Cecile Silvestre

Communications is one of the fastest growing fields of engineering opening doors for many new and exciting possibilities. Recently, an interview was conducted with Dr. Raymond L. Pickholtz, a professor in the EE/CS Department who specializes in communications. Our discussion focused on the research that he is now involved with at the George Washington University in his field of specialty.

One of Pickholtz's current projects deals with array processing. This involves the problem of sorting signals coming from different sources at the same time or with the same frequency. This project is now in its second year and is being funded by E-Systems.

A future possibility of a paperless and checkless society is within our grasp. This could be made possible by his other research called Satellite Command Link Security, which is funded by Intelsat. This deals with an encryption technique that incorporates digital signatures and data authentication. The method involves a form of secret-coding that allows a person to send bits of data to another person without fear of it being extracted for information when intercepted by a third party. The encryption scrambles the message on its way to another terminal. The receiver can unscramble it if he knows the code or his terminal is equipped with an encrytion decoding box. Therefore, this process ensures the integrity of the communication.

With today's problems in legal disputes due to forgery of signatures in stolen checks and credit cards or legal papers, a disinterested party such as a judge can now, in principle, settle disputes with the help of digital signatures. It is a method by which hand signatures can be replaced with a series of numbers. The millions and millions of combination of numbers possible make it highly unlikely that two people will have the same digital signature. Therefore, it is not only a way of validifying one's identity to the person he/she is communicating with, but also a measure of ensuring the security of the data transfer.

Such data security as discussed above will prove to be of great benefit to users in the future in terms of privacy, authentication, identification, and verification, because it will greatly minimize the chances of tampering and breaking in of systems incorporating these techniques. However, as Dr. Pickholtz himself states, "Nothing will ever be 100% foolproof."

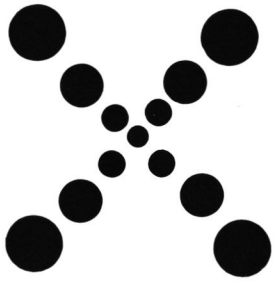
Imagine if you will, a world where transportation will be a necessity of yesterday; where the individual home will be the center of both work and play,

and the office building a sign of the past; where an entire library of information can be obtained within seconds. Such are the possibilities proposed by the work of Pickholtz's most recent project. Funded by MCI, it is referred to as Broadband ISDN (Integrated Services Digital Networks) and Fast Packet Switching. The objective is to construct a network using fiber optics in a way that a number of computers can work interconnectively to provide a whole range of new services in communications. This implies that the processing of information must occur at rates much greater than those capable by modern electronic techniques. The solution involves using fast packet switching in which information is bundled together and transmitted in little packets (self-contained electronic bits). This method will allow for a five order of magnitude increase in processing speeds. For example, consider the modern telephone which transfers data at a rate of 16,000 bits per second. Using fast packet switching the simple telephone can be integrated to provide rates ranging in the giga bits per second to give voice, pictures, graphics, etc. However, with today's electronics unable to meet these high speed requirements, the problem now is to design a network which can.

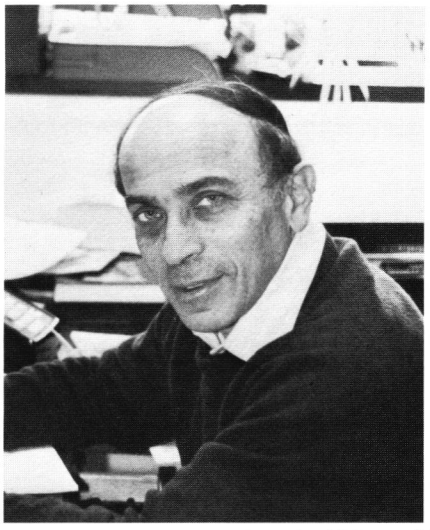
Dr. Pickholtz is also doing research in what is known as Spread Spectrum Communications which is an unfunded project. He is presently the editor of a journal entitled *The IEEE Journal on Selective Areas of Communication* (expected to be published in 1990) which is devoted to the work he is doing in this area. Spread Spectrum Communications involves a means of communications which uses bandwidths far in excess of those currently used. Thus, what essentially occurs is that the signal being transmitted is spread out over the entire range of the electromagnetic spectrum rather than confined to a small segment over which it can operate. This then allows the transfer of code that is uniquely addressable for only the users involved, screening out interference from all other undesired signals. Traditionally, this form of communications was utilized in the military for jamming and interception techniques. However, Pickholtz is gearing his research towards applications ranging from mobile to satellite communications, in which the entire spectrum mentioned above would become more available to the public.

His fifth and final project is one in which both he and Professor Saha are engaged in, and is referred to as Bandwidth Efficient Coding for Mobile Communications. A proposal concerning a new coding and modulation scheme, written with Professor Saha, was submitted late last year to the National Science Foundation (NSF) Presently they are awaiting word for possible funding for their research from the NSF

The innovative technological advancements suggested by Dr. Pickholtz's research are still in its early stages, but may not be too far from realization since he predicts that they will be likely used by the year 2000. Currently, the tests conducted for these projects are either done theoretically or by computer simulations. This is primarily because billions of dollars would be required to obtain the necessary equipments and a huge facility to conduct the actual experiments. Not only will financing be a key factor in the implementation of these ideas in the future, but also the social and political climate of the society at the present time.



As a final note, the MECHELECIV staff would like to thank Dr. Raymond Pickholtz for his patience, effort, and time in making this interview possible.



Courtesy of Mohab Akhnoukh

Dr. Raymond L. Pickholtz is currently a professor in the Department of Electrical Engineering and Computer Science at the George Washington University where he teaches, does research on computer communications, and directs an Industrial Liaison Program. He received his Ph.D. in Electrical Engineering from the Polytechnic Institute of Brooklyn in 1966. During this time he was a researcher at RCA Laboratories and at ITT Laboratories. Since then he has been an active participant serving as a committee member and holding editorial positions in numerous organizations and societies. Presently, he is the editor of the Telecommunication Series for Computer Science Press and, since 1986, the Vice President of the IEEE Communication Society.

In addition to teaching in universities here and abroad, Dr. Pickholtz has lectured extensively in the United States, Canada, Europe, and South America on various aspects of communications. Aside from having published and patented many of his works, he was also the recipient of the RCA Laboratories Research Award for outstanding contributions for the color television.

SIBERT: Research Advances with the Computer Graphics and User Interface Group

Interviewed by

Swati R. Patel

The Computer Graphics and User Interface Research Group was formed approximately 10 years ago by two faculty members of the Electrical Engineering and Computer Science Department of the George Washington University. These two members are Dr. James D. Foley, Chairman of the EE/CS department, and John L. Sibert, Associate Professor in the EE/CS department.

When interviewing Professor Sibert about GW's Computer Graphics and User Interface Research Group, many interesting details were discovered about the research opportunities available to GW students in the area of computers.

The research group was initiated by Professors James Foley and John Sibert in a common effort to meet regularly for the purpose of introducing new members to past work, sharing information, making presentations of relevant research, and helping develop new ideas and skills through intellectual stimulation and constructive, critical discussions.

Professor Sibert explained that the group has short and long range goals. The former is to provide a forum for the exchange of research ideas and to test these ideas out. For example, many of their members who are graduate students present their dissertation proposals to the group and attain constructive feedback from the group. Thus, the student not only gets a trial run in presenting his dissertation proposal, he/she also gets supportive assistance on his/her dissertation topic. The group also helps those members who are speaking at conference seminars elsewhere. They do this by listening and providing effective criticism on their presentations.

Another short range goal is to provide all members of the group with information of new research developments. This is of course done by bringing in speakers from other institutions where similar research is being done. As Professor Sibert continued to explain, the long range goal of the group is to provide a sense of community to all the members of the group. From the student's point of view, they can always feel the security of knowing that people in this group can assist them throughout their research project. So, in the long run, for a graduate student, the support and assistance offered by this group can help not only in terms of learning new research ideas and having people to share relevant ideas with, but also in terms of increasing their morale during this time consuming and sometimes disheartening research process. From the faculty's point of view, there is always a fresh new supply of interested graduate students. The faculty is there to provide both the research and the educational opportunities.

Some of the current research projects that the group is involved with are as follows:

- User Interface Designer's Aide:
— The user-computer interface is often the major impediment to successful use of interactive computer graphics systems. Design of the interface is often thought as art rather than science, and suffers from lack of formalisms, models, tools, and methodical design approaches. Slowly, the design process is becoming more structured, and more formal tools are becoming available. The goal of this project is to create a User Interface Design Environment (UIDE), a knowledge based system to assist in user interface design and implementation.
Project members: James D. Foley, Won Chul Kim, Srdjan Kovacevic, and Kevin Murray
Sponsor: National Science Foundation

- Software for Improved User-Computer Interfaces:
— The focus of this project is to develop software tools which facilitate the design and implementation of high-quality, "user-friendly" user-computer interfaces. This project extends the current work with UIDE in three areas: Keystroke-level analysis of user interface designs, intelligent help systems, and the interface to UIDE itself.
Project members: James D. Foley, John L. Sibert, Hikmet Senay, Lucy Moran, Piyawadee Sukavirija
Sponsor: Software Productivity Consortium

• Relationships in the Formal Specification of User-Computer Interfaces
—The objective of this project is to investigate the role of relationships in formal specifications of interfaces, and enhance our Interface Definition Language (IDL) accordingly. The IDL may be characterized as an object-oriented, non-procedural language for the description of interface behavior.
Project members: John L. Sibert, Yoav Intrator
Sponsor: IBM T.J. Watson Research Center

• An Intelligent Tool for User Interface Prototyping and User Interface Management:
—Several years of research in tools for rapid prototyping of human computer interfaces have culminated in the development of the George Washington User Interface Management System (GWUIMS). This project focuses on an iterative development of GWUIMS into a usable interface prototyping and development tool.
Project members: John L. Sibert, Terry Bleser, David Hurley, Yan Cheng
Sponsor: NASA-Goddard Space Flight Center

• Visualization of Three-Dimensional Fractals Based on Iterated Function Systems:
—Fractals are useful models for the irregular geometry of many naturally occurring phenomena. The goal of this research is to develop a general purpose visualization system for three-dimensional fractals based on iterated function systems.
Project members: Laurie Reuter, Hubert Ulrich
Sponsor: George Washington University Committee on Research

• Knowledge-Based Advisory System for General Scientific Data Visualization:
—Scientific data visualization is becoming increasingly useful as a tool for discovering facts and relationships that are often hidden in large data sets, like those typically found in the earth and space sciences. However, very often the scientists who could most benefit from such tools lack the expertise and time required to produce effective visualizations. Using artificial intelligence techniques, this project will lead to an expert system that can advise scientists on the selection and creation of effective scientific visualizations for their particular data.
Project members: James D. Foley, John L. Sibert, Laurie Reuter, Hikmet Senay
Sponsor: NASA-CESDIS Universities Space Research Association

Some potential research projects that the group is interested in are as follows:
(1) Visual Presentation of Science and Engineering Data
(2) Interaction Techniques with Non-Traditional Interactive Devices
(3) Graphic Debugger for Knowledge-Based System Designers
(4) User Modeling in Intelligent Interfaces
(5) Automatic Help Text Generation from Knowledge Representation
(6) Operating System User Interfaces

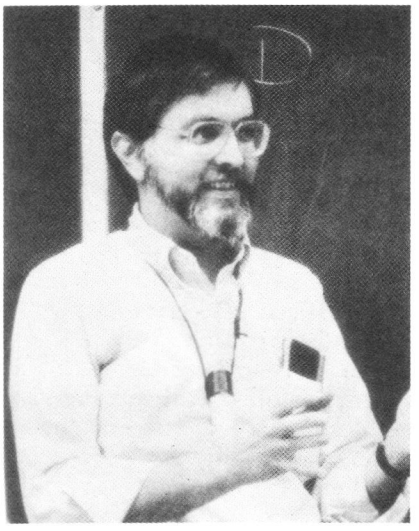
Projects are frequently based on previous research projects which are funded by the same sponsors. The majority of the group's work, as Professor Sibert relays to us, is to study and formulate the models necessary for the development of user interface systems. The enthusiasm and extensive research that exists in these projects makes the group and its many opportunities an attraction for new faculty and graduate students.

If further detail is needed on any of these research projects, then one should meet with Professor John Sibert or Professor James Foley.

Some of the relevant graduate courses to these research projects are: CS 174, CS 185, CS 219, CS 319, CS 222, CS 297-10, CS 322, CS 324, EAd 290, MgtSc 243, and EngS 283.

REFERENCES: "Computer Graphics and User Interface Research at The George Washington University", a pamphlet for the Computer Graphics and User Interface Research Group

The MECHELECIV Staff would like to thank Professor John L. Sibert for his time and effort taken in the making of this interview.



John L. Sibert - is currently an associate professor in the EE/CS department. His research interests include: computer graphics, human computer interaction, applied artifical intelligence, and object-oriented programming languages. He received his AB in history from Wittenberg University in 1968, MA in geography from Miami University in 1971, and PhD in geography from University of Michigan in 1974. He is an executive committee member of the Technical Committee on Graphics in the IEEE Computer Society, editorial advisory board member for NCGA, and associate editor for the Association for Computing Machinery (ACM). He was the program chair for 1988 SIGGRAPH Symposium on User Interface Software, and is now the general chair for the 1989 SIGGRAPH/SIGCHI Symposium on the same topic.

Flouroscopic Visualization of the Heart for Cardiac Surgery

by Zuhdi Jaouni

THE heart must adapt its performance to the widely varying needs of the body in order for each organ to receive enough blood to support its metabolic requirements. The heart consists of two pumps. The right heart accepts venous return and pumps it through the pulmonary vasculature for oxygenation. The left heart then prepares the oxygenated volume of blood for distribution throughout the systemic circulation.

Heart disease is a major cause of illness and disability and is the leading cause of death. Systemic congestion is commonly caused by right ventricular diastolic pressure, as well as right atrial and systemic venous pressures. As a result, the jugular veins become engorged. The liver becomes enlarged and tender. In the common circumstance where right heart failure follows left heart failure, the lungs will become less congested and the liver will become severely engorged. A common result of right heart failure is relative incuspid insufficiency. The cardiac catheterization may show a typical pattern that reveals the mechanical nature of the obstruction. If the tricuspid valve is narrowed, a diastolic gradient of pressure is observed between the right atrium and the right ventricle.

Pulmonary congestion is commonly caused by left heart failure, which leads to an increase of the left ventricular diastolic pressure and of the left atrial and pulmonary venous pressures. As a result, the pulmonary capillaries become engorged. A common result of the left ventricular failure is relative mitral insufficiency. Left heart catheterization shows an increase in the diastolic pressure of the left ventricle, as well as an increase of the left atrial.

SYMPTOMS

Angina, dyspnea, and fatigue are the most frequent cardiovascular complaints.

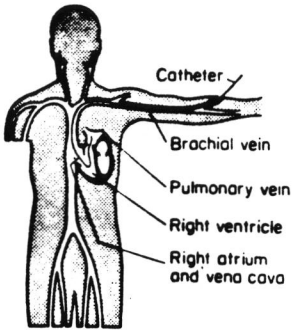
ANGINA: is the most common pain in cardia diseases, usually leading to coronary artery disease. Typically, angina is a squeezing substernal chest pain that may radiate to the neck and jaw, or to the shoulders, down the arms, and into the fingers. It is usually releaved in a few minutes by rest.

DYSPNEA: is a symptom of shortness of breath. The patient feels that he is unable to get enough air, and often complains of a choking sensation. Dyspnea may be present only after exercise, and is not necessarily specific for cardiac disease. Dyspnea that interrupts a patient's sleep is a characteristic of cardiac disease.

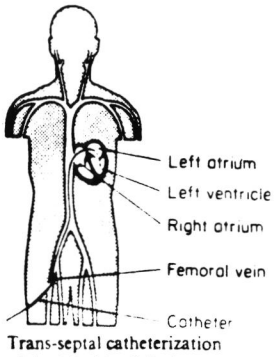
FATIGUE: Being tired and having no energy to do anything is a very common cardiac complaint. The heart is unable to adequately supply oxygen to the body's tissues, particularly during exercise when oxygen demands are increased.

WHAT IS CARDIAC CATHETERIZATION?

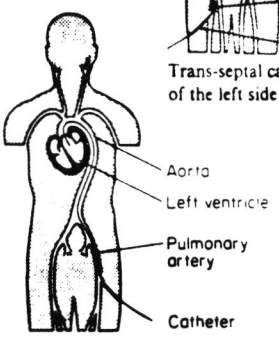
A patient who is being considered for cardiac surgery for any reason should probably undergo a careful cardiac catheterization. This is a procedure in which catheters are introduced into the heart under flouroscopic visualization for informational, diagnostic, and therapeutic purposes.



Catheterization of the right side of the heart



Trans-septal catheterization of the left side of the heart



Retrograde catheterization of the left side of the heart

TECHNIQUES

Right Heart Catheterization

The purpose of right heart catheterization is to study the conditions of the chambers and great vessels of the right side of the heart. The procedure starts, using local anesthesia, by introducing a radio-graphic catheter into a vein. Once the catheter is inserted into the vein, it should be advanced toward the heart. After an easy passage for two centimeters or less, the catheter jams and further passage becomes difficult.

There are several possible reasons for this. The most common is probably the failure to insert the catheter into the lumen of the vein. This is particularly the case if a messy incision has been made and the blood is not kept carefully wiped away. An uncommon reason for the catheter sticking is that the vein has narrowed.

Catheterization is manipulated under flouroscopic control, downstream through the venous system to the right atrium and eventually into the right ventricle. It may be difficult to enter the right ventricle, either because the catheterization is being performed from below and therefore, the tricuspid orifice is difficult to reach, or because the catheter tip has become straightened in the course of its passage into the heart.

The manipulation of the catheter from the right ventricle into the pulmonary artery is easily achieved when the catheter passes from the left arm, since there is a natural tendency for the catheter to form a wide loop which passes from behind, forward through the ventricle and out into the pulmonary artery. Once in the pulmonary artery, it is usually a straight-forward matter to obtain blood samples and wedge pressures.

Left Heart Catheterization

The goal of left heart catheterization is to study the conditions in the chambers and vessels of the left heart. In congenital heart disease, the catheter may reach the left side from the right heart chamber, passing though the septum. The most common and satisfactory approach to the left ventricle is by retrograde catheterization of a peripheral artery, followed by the passage of the catheter through the aortic valve into the left ventricle. This can be seen at flouroscopy and is usually heralded by two or three vetricular extra-systoles, as the left ventricular outflow is always sensitive to the presence of the catheter. The catheter is gently introduced further into the left ventricular cavity in an attempt to place the catheter tip in the center of the ventricular cavity or towards the cardiac apex.

DETEMINATION OF CARDIAC OUTPUT

The amount of blood the heart propells forward is called the cardiac output. The determinaton of cardiac output is an important technique in cardiac catheterization. A low cardiac output indicates that the heart is unable to provide the tissues with an adequate blood supply. The normal cardiac output is six liters per minute.

There are two main methods of cardiac output determination:

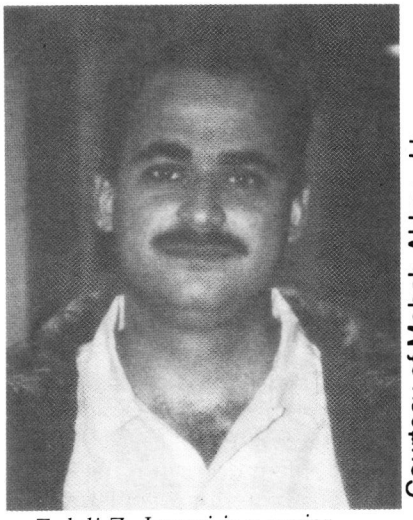
1) Fick Principle: which relies on the assumption that oxygen delivery to the blood through the lungs and oxygen extraction by the tissues is the steady state at the time of measurement. Therefore, normal oxygen consumption is 240 - 300 milliliters per minute. The mixed venous oxygen content is about 15 milliliters per 100 milliliters and the arterial blood is 19 milliliters per 100 milliliters. Applying these values to the Fick equation gives:

2) Indicator Dilution Method: is based upon the measurement of the concentration and dispersal of a dye which is injected centrally and sampled at a peripheral arterial site. The arterial sample is continuously withdrawn through a sensing photoelectric cell by a constant flow pump. The cardiac output is computed from the known dose of the injected indicator and the area of the time concentration curve.

COMPLICATIONS

As a result of these manipulations, the patient is tired, hungry and often complains of a backache or of a pain in the arterial puncture site. Supportive treatment to make the patient more comfortable is greatly beneficial.

The patient frequently becomes nauseated, complains of dizziness or lightheadedness, and becomes diaphoretic. The blood pressure may be extremely low during these episodes and the heart rate may be as low as twenty or thirty beats per minute. The condition is treated by reassurance, elevation of the patient's feet, and intravenous administration with fluids and atropine. One should consider additional anxiolytic medication if this situation arises. ■



Courtesy of Mohab Akhnoukh

Zuhdi Z. Jaouni is a senior, majoring in Electrical Engineering with Premedical Engineering option. He is the vice-president of the Engineers' Council, as well as the School of Engineering and Applied Science senator for the GWU Student Association (GWUSA) for the Fall '88 to Spring '89 school year. His interest is in medical engineering research, and he plans to work towards a Master of Science in Medical Engineering.

BOCK: A Step Closer to Artificial Intelligence

Interviewed by Chong Bum Lim and Nelson M. Kee

"ARTIFICIAL intelligence is the ability of human-made machine (an automoton) to emulate or simulate human methods for the deductive and inductive acquisition and application of knowledge and reason." (Peter Bock)

EXPERT SYSTEMS

Much of the work done in the field of Artificial Intelligence (AI) has consisted of work on so-called expert systems, where knowledge is programmed into a machine which enables it to assume a role of being an expert in some sort of application domain. According to Professor Bock, there are three criteria that must be met by the expert system before it is considered to be viable:
1) The problem domain must be small, i.e., the number of roles has to be manageable.
2) The problem domain must be static, i.e., the requirements must not continually change.
3) The area of expertise needs to be accesible and encoded into rules.
Typically, these systems have provided assistance to people in fields such as medicine (i.e. the classification of a blood disease).

THE GOAL

Due to the restrictions on current expert systems, Peter Bock is " . . . interested, ultimately in building a machine which is not an expert in a small area, but has the intellectual, emotional, spiritual . . . capabilities of human beings . . . that is, as robust as we are." He concedes that the three necessary conditions are not met at this time. The basis of Bock's ambitious goal is his belief that the " . . . human brain is a finite machine, albeit extremely complex." Research has revealed that the brain and central nervous system consists of about 10 to the 11th neurons, each of which is capable of storing about 10 to the 4th bits of information. Therefore, the brain has an information capacity of about 10 to the 15th bits. About 90% of this capacity is devoted to support functions and about 10% to cognitive processes. Thus, the human brain's intelligence base is on the order of about 10 to 14th bits. Past data reveals that random-access memory has increased by about an order of magnitude every six years, a generation. Therefore, Bock estimates that by 2024-2030 AD (that is, after 13 generations), the memory capacity of large computers will reach 10 to the 15th bits of information, the capacity of the brain.

THE APPROACH

Collective Learning Systems Theory

Attempting to build a machine, with the capabilities of a human through the conventional AI methods of programming the facts and rules into the machine, is prohibitively difficult. Peter Bock estimates that programming 10 to the 14th bits of information would require 100 million person years. He feels that a viable alternative might be to allow " . . . an automoton to learn to solve problems through iterative trial-and-error interaction with its environment, much as humans do." In other words, the machine will learn from its mistakes. Bock has done pioneering work in this learning approach, which he calls the Collective Learning Systems Theory (CLST). According to this theory, the machine must have sensors that can analyze its environment and elicit a response. The environment then evaluates the response and notifies the automoton. The automoton then adjusts its strategy accordingly and generates a new response to the given stimuli. This iterative process continues until the automoton gives the correct response on a regular basis.

Collective Learning Automoton

At the heart of the CLST lies the Collective Learning Automoton (CLA), also simply known as the cell. Each cell can be classified under one of two classes: learning or non-learning. A non-learning cell has no history and therfore no memory. Its function is to transform stimuli into responses in a prescribed manner. On the other hand, a learning cell also performs the function of a non-learning cell. However, when it is presented with a stimuli, it selects a response according to the

cell's memory, its environment, its rules and the value of the stimuli itself. Furthermore, when evaluations from the environment are given, a compensation is generated and the memory is updated based on the compensation and history.

While receiving stimuli from the input stream, the cell can also receive stimuli from feedback by other cells (communication between cells) or itself via the feedback bus. Evaluations from the environment which govern supervised learning are also received. Since several stimulus may arrive at the same time for processing, a logical ring topology is used. It allows data packets to circulate indefinitely on the ring, traffic permitting. This in turn permits a cell which is temporarily busy processing a previous packet to accept the new packet during a subsequent circuit. Four types of interfaces are used in the ring:

1) Response Receiver Interface (RRI)
2) Feedback Receiver Interface (FRI)
3) Stimulus Transmitter Interface (STI)
4) Feedback Transmitter Interface (FTI).

Cells communicate with the rings through the STIs and RRIs. The feedback path interfaces with the rings through the FTIs and FRIs. Pre-processed sensor data is placed on the rings through the RRIs and the outputs from a ring are transmitted to the output post-processors through STI.

These individual cell modules may be organized in a hierarchy to perform more sophisticated tasks. At the first level, modules consist only of learning cells, receive stimuli and generate responses which go to the next ring. This serves as stimuli for the next level ring of the hierarchy, and so on. A cell may not use all of the data packet, or maybe none at all, as stimuli. To further aid in this, selector cells which can be learning or non-learning, are placed between the STI and the module to " . . . provide a global capability for pruning the set of responses for the entire module."

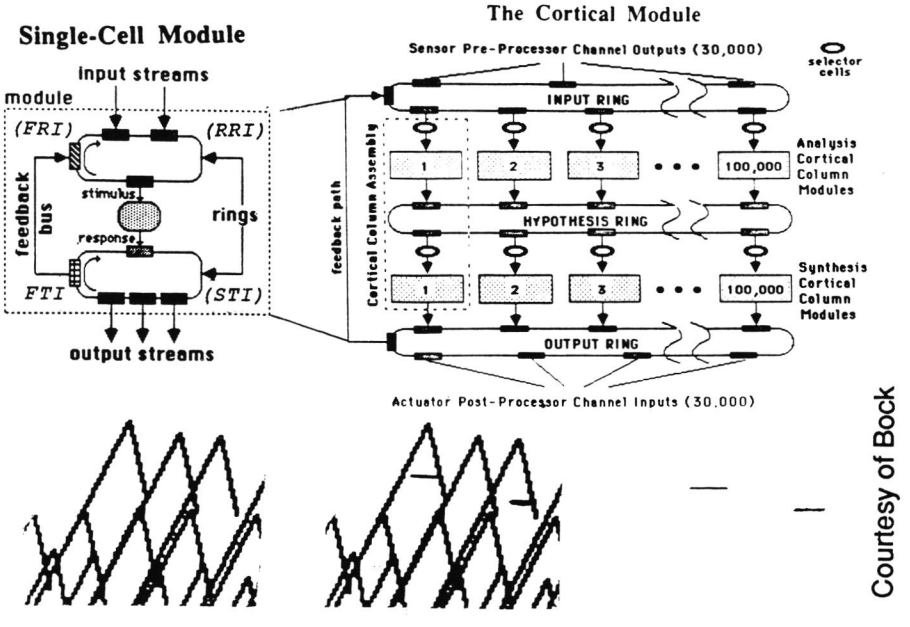
In summary, " . . . a collective learning system is a network of learning cells combined in modules which are hierarchically layered in such a way as to enable them to exchange messages and distribute the task(s) of the system. In this way, the system can learn to give complex, as well as accurate repsonses to input stimuli." Since 1970, Professor Bock has successfully applied this principle to simple one of two player games (i.e. chess or Othello), which require few learning cells.

Cortical Module

Peter Bock has also worked on a design massively parallel network of 100 million such learning cells which would simulate the cognitive processes of Analysis, Hypothesis, and Synthesis. When sensors acquire a complex set of stimuli, the stimuli are recognized and classified. Associating this with the memory and history of the cell, the cell reaches a Hypothesis. Based on this Hypothesis, the cell then synthesizes a response and realizes them through actuators.

An example of this process would be a kettle boiling. In the Analysis stage, through sensors (i.e. eyes, ears . . .), you sense an object in front of you [Sensation] and you detect that is red and white [Perception] and recognize that the white part is steam and the red part of the kettle [Recognition]. You decide that it is a kettle boiling [Classification] and associating it with your past experience [Association], you conclude that the water is hot enough to make coffee [Understanding]. Therefore, you come up with the Hypothesis, "I must pick up the kettle." Then, Synthesis translates the Hypothesis into a set of responses that divides to smaller sub-responses through Formulation, Decomposition, Instantiation, Synchronization, Integration, and Actuation, which commands actuators (muscles) that lift the kettle. Repeated trials (picking up the kettle bare-handed or with gloves) and external evaluations (your mother says to hold it tight so as not to drop it) reaffirms or changes the analysis and synthesis process.

To artificially realize the above scenario, one must first analyze and the try to duplicate the cerebral cortex, where all the cognitive processing in the human brain takes place. The cerebral cortex can be functionally as well as structurally



a) Tabula Rasa b) Test Image (with abnormality) c) Hypothesis (abnormality market)

Courtesy of Bock

divided into 100,000 subunits called cortical colunms for both the Analysis and Synthesis phases. Looking at the diagram of the Cortical Module, one can see that the input ring receives outputs from a set of Sensor Pre-processors (it is reasonable to assume that 30,000 parallel outputs like the human brain are needed), while the output ring sends its outputs to a set of Actuators Post-processors (also 30,000 parallel inputs). All the Cortical Column Assemby (CCA), consisting of an Analysis Cortical Column Module (ACCM) and Synthesis Cortical Column Module (SCCM), enjoy a fair amout of freedom from each other, yet there is a lot of direct communication and merging which is done through the Input, Output and Hypothesis rings. The feedback path from the Output ring to the Input ring will allow refinement of the responses before actually transmitting the responses to the Actuator Post-processors. However, improperly adjusted feedback parameters may cause hesitation or "acting before you think" behaviors, which are found in humans.

Since the human primary visual hypercolumn is many times larger and more complex than those in other parts of the cortex, it was chosen as the model for all CCAs to be based on. This ensures sufficient complexity throughout the Cortical Module.

According to estimated memory capabilities, it is estimated that 972 cells will be required for each CCA. Therefore, 54 Internal Column Modules (ICM) will be needed for each CCA, where each ICM contains 18 individual cell modules and these 18 modules could be arranged in a variety of ways (not necessarily the 6 by 3 shown, because no biological equivalent of the ICM exists in the human brain). One ICM could be realized by one transputer, which is essentially a high-speed processor with four ports, which are used to communicate with other transputers or external devices. The whole process would follow the cognitive process of the human through the various stages as illustrated by the kettle example.

THE RESEARCH

In May of 1989, Peter Bock will head an eight month, $200,000 research project sponsored by Bosch, a West German industrial firm. The research will be hosted by the Research Institute for Applications Oriented Knowledge Processing (FAW), which is directly affiliated with the University of Ulm in West Germany. A team of four G.W.U. graduate students: Carmen Kocinski, Hiliary Holz, Richard Rovner, and Glenn Becker, and three graduate students from the University of Ulm will assist Bock in this research. The purpose of the project is to design and implement a single Analysis Cortical Column Module (ACCM) for image processing, implemented as a network of 32 transputers and hosted by two Macintosh IIx computer systems.

Image Processing

The image will be scanned using a hierarchy of overlapping templates of different resolutions. A "token," which consists of a 3 x 3 matrix of pixels, is the lowest level template. A "frame," which consists of a 3 x 3 matrix of non-overlapping tokens, is the next level. A "window," which is a 5 x 5 matrix of non-overlapping tokens, is the highest level. "The window is scanned by moving the frame through 9 overlapping positions from left to right and top to bottom. The 9 tokens captured in each position of the frame are passed to the indicated ICM in the first rank of ACCM, a total of 81 tokens. The window is then shifted 3 tokens to the right and the next 81 tokens are passed to the ACCM. When the entire width of the image has been scanned, the window is shifted back to the left edge of the image, and down by 3 tokens. This process is repeated until the entire image has been scanned." A complete scan of a 270 x 270 image, 841 windows, will be completed in 84 milliseconds.

The ACCM first uses unsupervised learning (Classical Conditioning) to analyze images which are structurally similar. These images, which are devoid of abnormalities, are called "Tabula Rasa" (empty slate) and are used as a basis for comparison to other images. When the ACCM genterates a blank image on the Output Ring, the Tabula Rasa (i.e. satellite photos of deserts, forests, mountains, bodies of water, etc.) is classified as normal. The second stage would be to introduce a test image containing an abnormality (i.e. various shapes, sizes, distributions) in the Tabula Rasa. The Hypothesis Ring outputs an image with the pixels of the abnormality marked. "On the basis of the accuracy of its hypothesis, supervised learning (Operant Conditioning) will refine the previous unsupervised learning based instances of the Tabula Rasa." Bock expects " . . . that the Tabula Rasa will be learned in a few minutes, and that the analysis of an abnormal image will require less than 200 milliseconds, times which are comparable with human requirements for the same task."

An example of this might be the child's game, where once familiarized with a particular scene (unsupervised learning), the child is asked, "What is wrong with this picture?" He will then point out the abnormalities (Hypothesis) of the picture based on his previous knowledge (Tabula Rasa). Then, the parent evaluates his answer and will tell the child if he is right or wrong (supervised learning). This process will repeat until the child is consistently correct is his hypothesis.

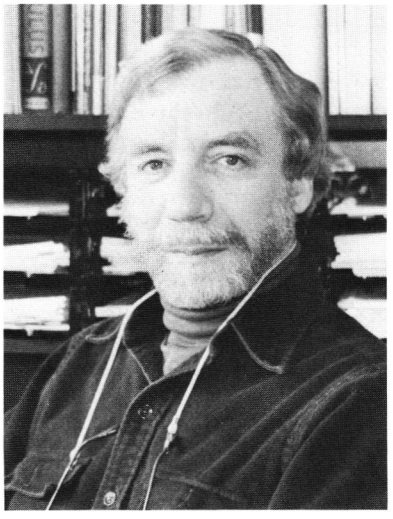
Bosch hopes to implement the technology acquired through Peter Bock's research in an automated car of the future. The system would warn the driver of changes in the environment (i.e. road conditions). If the project is successful, Bock is optimistic about

attracting other funding to build an even more complex system consisting of a larger network of transputers.

SOMETHING TO THINK ABOUT

Peter Bock has raised an interesting question in the past. "What do you suppose is in store for us in generation fourteen (when the computer memory capacity exceeds that of humans)?"

We would like to thank Professor Peter Bock for granting us the two very interesting and informative interviews which made this article possible. On behalf of MECHELECIV, we would like to wish him and his party the best of luck and success with their research in Germany.



Courtesy of EE/CS dept.

Peter Bock is an Associate Professor at The George Washington University's Department of Electrical Engineering and Computer Science (EE/CS). He has been a member of the EE/CS faculty since 1970. His areas of specialization include: Computer Science Education, Artificial Intelligence and Robotics, Data Communications and Local Area Networks, Microprocessor Systems Design and Application, and High-level Language Design. He received his BA at Ripon College and his MS from Purdue University. Bock is regarded as an expert as well as a pioneer in the field of Artificial Intelligence. Currently, Professor Bock is writing a book entitled ***Learning to Learn: The Emergence of Personal Artificial Intelligence.***

SOLAND: Acting OR Chairman Presents the Research Activities of the OR Department

Interviewed by

Thomas Doherty

PROFESSOR Soland is the acting Chairman of the Department of Operations Research. He will become chairman on July 1, 1989. The following is the interview.

Q. In a nutshell, what is Operations Research (OR)?
A. OR might be concisely defined as mathematical modeling and computer solutions for better decisions — better decisions for private firms, public agencies, non-profit institutions and the military.

Q. What role does OR play in an Engineering School and why is it found in an Engineering School instead of a Business School?
A. The people who originally developed OR came from the physical sciences. They were not necessarily engineers, although there were some. There were also a number of physicists and chemists.

OR has always been a very quantitative area. I think that is one of the reasons that it often does better in an Engineering School, because the techniques involve modeling. Engineers do a lot of mathematical modeling, for example, setting up differential equations, and the modeling of circuits and networks. Except in Business Schools that have a very strong quantitative component, OR just does not work out so well in its more mathematical forms. OR also has a number of close connections with Industrial Engineering School.

Q. In what areas is research being pursued by members of the faculty?
A. In this department there is a division into two areas:
1) mathematical optimization
and
2) stochastic modeling.
In both areas, almost everyone has a world-wide reputation. On the mathematical optimization side, the things being pursued are new and better techniques of mathematical optimization for both linear an nonlinear programming problems.

A few years ago, a new technique was published for linear programming problems (Karmarkar's Algorithm) that seemed revolutionary. However, it turns out that a similar idea was developed by two of our faculty, Professors McCormick and Fiacco, back in the late 1960's for non-linear programming. Professors Fiacco, McCormick, and Falk are all actively working on techniques for both linear and non-linear programming. Professor Fiacco works on sensitivity analysis, and Professor McCormick develops more automatic methods of optimization that allow people to build complex functions from simpler functions. Professor Falk works on a number of different problems, such as, missile defense problems, non-convex optimization (where there are a

number of local optima and it is difficult to find a global optimum), and game theory. I place Professor Marlow in the mathematical optimization side. He has worked on a lot of logistics problems for the Navy and on readiness problems for the Marine Corps. He has also worked on a number or statistical problems related to readiness.

On the stochastic modeling side, there are Professors Singpurwalla, Miller, and Gross. Professor Singpurwalla works on reliability problems, including software reliability. He also works in the areas of forecasting and Bayesian statistics. He holds a joint appointment in the Department of Statistics. Professor Miller works in stochastic processes, particularly some that arise in polymer engineering and certain aspects of chemistry and chemical engineering. He also works in software reliability and in simulation. Professor Gross is on leave this year and is an expert in queuing theory and co-author of one of the more popular books on queuing. He also works on inventory problems.

That leaves myself, and I have one foot in each camp. I work in multiple criteria decision-making and some types of stochastic problems in decision-making. I am also interested in certain types of discrete optimization problems, particularly non-linear problems.

Q. About what percentage of the OR faculty are involved in research activities?
A. All members are invoved in research.

Q. In your opinion, what role does research plays in an educational/academic institution?
A. Research plays an important role because it keeps us at the forefront of certain areas, so that we can bring in knowledge of what is currently going on, what is important and interesting, and talk about these things to our students in classes when the appropriate time or subject comes up. One of the more difficult things in science and engineering is staying current. Research helps us stay current and by transmitting some of that to our students, I think we improve their education.

Q. What research institutes are affiliated with the Department of Operations Research? Briefly describe the research efforts in these institutes.
A. The Institute for Reliablity and Risk Analysis that Professor Singpurwalla heads is performing research into reliability, forecasting, Bayesian Analysis and statistics. The Institute is actively involved in developing computer software for its different research areas. The Institute has been very active in terms of supporting graduate students and bringing visitors over here while collaborating on research with the Institute.

The other institute in the department is the Institute for Management Science and Engineering headed by Professor Marlow. The Institute is not as large as it has been in the past, when it was concerned with all types of logistics problems. Now it serves as an umbrella for a lot of the research that is going on in the OR Department.

Q. In what ways may an undergraduate student participate in research in the Department of Operations Research?
A. There is the Honors Research Program and of course students can ask to help faculty on some of their research projects.

Q. In your opinion, what has been Operations Research's greatest accomplishment?
A. It has enabled people involved in a wide range of areas to apply quantitative methods to analyze problems and come up with better solutions to them.

Q. Of all the areas that OR is applied to, which do you feel is the most beneficial and rewarding?
A. OR is applied to areas of the public interest, and these can be very beneficial in the sense that they help all of society. If OR is used to organize agriculture in a third world country to improve food supply, I think that contribution is quite large and beneficial. Other areas are in energy and in enviromental protection. If the E.P.A. uses OR techniques to help clean up the environment then everyone benefits. OR models have been used a fair amount by the E.P.A. to do just that.

Q. What is the future of OR? What areas will be the most interesting or applicable to research in the future?
A. A little less than two years ago, Dr. Gross was co-chairman on a symposium that looked at the future of OR. It was called CONDOR, Comittee on the Next Decade in Operations Research. A lot of the discussion centered on gaining a better understanding of stochastic processes that occur in manufacturing processes and other areas of society, so that we can model these better and therefore make better decisions. Advances are also sought in areas such as integer programming, because they can yield more efficient solutions to problems in such areas as scheduling and distribution. Multiple criteria is another area — while a lot of work needs to be done, just getting people to always think in terms of multiple criteria would be better.

□□□□□□□□

FOX
CMEE Research Activities
Revealed by the Department Chairman

Interview by Taraneh Amin

MECHELECIV interviewed Chairman Raymond Fox of the Civil, Mechanical, and Environment Engineering (CMEE) Department. This interview follows.

EULER V UY

Q. Could you please explain when and how you assumed the chairmanship of the CMEE department? A. I am currently completing four years. It was at the end of Professor Gilmore's term in July of 1985 that I was asked to serve as chairman, while a nation-wide search was conducted. My name would be recommended to the Dean, it was approved, and I took the chairmanship in 1986.

Q. What are your responsibilities and duties as chairman of the department? A. Part of the responsibility of a chairman is to make certain that administrative tasks of the department are handled. Decisions must be made concerning what classes and how many sections should be offered, which faculty members will teach them, and decisions concerning the utilization of part-time faculty.

Q. If there are any comments or complaints from the students, would those come to your office? A. Yes, these problems do come to me, and I either handle them myself, refer them to faculty member who may be better able to handle the problem, or refer it to the Dean's office, if necessary. Most of the problems are solved within the framework of the department.

Q. When you assumed the chairmanship in 1985 what goals did you set for the department? A. Essentially, I am holding down an office here to assist the department faculty. The faculty of the department are really the body and soul of the department. If they say we ought to be doing this, or making these modifications, my purpose is to assist them in doing those things.

When I first came in, our goal was to strengthen Mechanical Engineering and Computer-integrated Manufacturing, so we brought in Professor Kramer. We also built up some courses in this area at the graduate level.

One of my own goals is to assure that the faculty work as a team, branch out to other departments, and work together with other department faculty. For example, Professor Gilmore collaborates with David Ramker who is in the Chemistry department, when we have interests in the area of materials science. In our computer design manufacturing, we collaborate with some of the people in the EE/CS department. If anything, my goal has been to encourage teamwork both within the department and within the school as much as possible because I think a lot more can be accomplished that way.

This collaboration with outside departments can lead to new programs such as the Aeronautics and Astronautics program that is now on campus and has been at JIAFS in Langley Virginia. A number of faculty and students have shown interest in this project, so we are starting at the masters level, and will eventually have students in the program at the undergraduate level.

Q. Are you happy with the results so far? A. I would like to see more research being generated. The faculty have put out proposals, but many of these projects have to be funded by federal funds and federal government agencies. Money is very hard to come by, particularly in large amounts. We have quite a few programs with the Navy, where we have collaborative research and off-campus programs. There has been some accomplishments. I think we have to be realistic in that right now money is tight and hard to come by. We cannot just expect it to fall into our laps or in the amounts that we would like. People get approximately $25,000 - $50,000 grants. We used to have even $150,000 - $200,000 grants. It doesn't come easy anymore.

Q. What do you think is the CMEE department's greatest strength? A. The greatest strength we have is that we are united in that the faculty respect each other. It could be very easy for us to divide to Mechanical Engineering and Civil Engineering. Instead, we now have a commonness of purpose. We work well together. There is no back-biting among the faculty. We recognize our respective weaknesses and try to be supportive.

Q. What are the CMEE department's greatest weaknesses? A. In some areas, we do not seem to integrate certain courses as much in the programs. The programs could be stronger if we could get some of the faculty to move just a little bit to the left or to the right of their own area. It would strengthen some of the other things.

Faculty are like wild horses. All the department chairman or the Dean can do is say, "Hey all horses, let's all go in this general direction." As long as we don't wander off too far, we are not going to fall in canyons. We have a spirited group of very talented horses. Some want to wander off and try other things.

We are trying to strengthen and remedy these weaknesses by conversation. I think we have come a long way. With respect to our undergraduate accrediation, we hope to have no particular problems.

Q. What percentage of the CMEE department is undergraduate? A. Graduate students are predominantly part-time. Two-thirds to three-fourths are part-time. There are two to four times as many graduate students as we have undergraduates. The undergraduates are full-time, and the substantial number of graduate students are working here for government or consulting engineers in the area.

RESEARCH ACTIVITIES

Q. What role does research play in an academic institution? A. Research is the kind of mental exercise and achievement that faculty accomplish at the same time students are going through the exercise of learning some new material. I think that in an academic institution, the faculty cannot just be doing research, but they have to be involved in the fields that they present to their students whether it is in association with professional societies, consulting activities that are perhaps available, or through research efforts. Engineering is not the same as in many fields, where much of the fundamentals never change. Changes in some of the problems in engineering mechanics are much more dynamic.

Q. What companies are faculty affiliated with in terms of research? A. Some work with the Naval Research Laboratory. Some are preferably involved with the National Institute of Science and Technology, which used to be the National Bureau of Standards. At other times, their work is funded by the National Science Foundation (NSF).

For example, Professor Yang and Professor Sarkani do some work with a consortium of universities with an earthquake engineering research center. It is located primarily at the State University of New York at Buffalo. Professor Kipor is doing work with NASA in Goddard. Professor Garris is doing some work on propulsion. Professor Mahmood has been working on a research on water resources areas, funded by A.I.D and NSF. Professor Kramer with some associates is concentrates mostly on robotics. Other work is with the National Institute of Health and the National Bureau of Standards.

Q. How does a professor play the dual role of instructor and researcher? A. It is not really a dual role. They run hand-in-hand. In the undergraduate program, we bring in some examples of currently developing areas of knowledge, but at the graduate level, many times the sponsored research provides funding for the graduate students. Graduate students work on research projects, and an outgrowth of that research may be his dissertation or Master's thesis

How is an academic institution influenced by the research activities? Professors working in structural engineering usually teach the courses in structural engineering and reliability. They are not going to be teaching a fluid mechanics course. So, it tends to be a reinforcement of their instruction from their research.

Q. How do you assess the research activities done by CMEE faculty members? A. It is more in terms of some of the publications that come out. For example, Professor Jones and Professor Eftis have doctoral students working in fractural engineering and plasticity studies. The doctoral students are coming out with their dissertations, and going into fields of research on their own, as they graduate. That is a very positive measure of their research effort.

Q. How do undergraduate students participate in these research activities? A. We have an Honors Research Program for good undergraduate students interested in research. They become involved with some of the faculty that are leading certain research projects. Professor Kaufman has led that effort for some time. The professors have very original ideas and stimulate the students to look into some research projects on their own. Some of it is directed toward the sponsored research, while others are directed toward the individual research that professors do.

Q. Do you have any additional comments on the research activities? A. These days, it is so difficult for faculty to get good sponsored reseach funds. Professor Eftis was just saying that certain agencies get comfortable with one institution, and no matter how good an idea or proposal is submitted to these agencies, they still keep supporting those places. Sometimes it gets discouraging for some of my colleagues, and yet they keep battling it out. Government agencies particularly hate to change horses in midstream. Change is troublesome to some of these

contracting officers. The Dean is very supportive of all the efforts of my faculty in terms of research. He leads us to agencies that may have needs. He opens doors and encourages some of my faculty to walk through the doors. Many of these people have very good ideas, and they are just not being utilized as much as they could be.

Q. Did you say that we used to get more funds before? A. For the last five years, the government has really cut back on research. They are spending money on a lot of programs, but they are not funding as much research as they used to. Universities in many other countries apply for research grants and funds from our government agencies. We tend to depend on government agencies, since we are not next to General Motors to show them our manufacturing techniques, and we are not near the aircraft industry. We have depended on the federal government, because that is out only source here. With some of the high-tech companies that are moving in, this is opening up some new possibilities.

MECHELECIV would like to thank Chairman Fox for doing the interview.

Raymond R. Fox is Professor of Civil Engineering at George Washington University in Washington , D.C. where he has been a member of the faculty since 1959. He is Chairman of the Department of Civil, Mechanical, and Environmental Engineering. Professor Fox recieved his Bachelor of Science degree in civil engineering(1949) and a Master of Science degree in civil engineering (1952) from the University of Washington specializing in structural engineering and soil mechanics. He did further graduate study toward a Ph.D. at Northwestern Univerity specializing in structural engineering and soil foundation engineering.

Professor Fox is a registered professional engineer in a number of states including Washington, Maryland, District of Columbia, Virginia, etc. He is an active member in a number of professional and honor societies

KIPER: Space Station Development Enhanced by Thermal Management Systems

Interviewed by Taraneh Amin

Ali M. Kiper is the Mechanical Engineering Curriculum Chairman. He received his Doctorate degree at Purdue University. He worked in industry many years as project, research, and plant engineer before joining the academia. He is a registered professional engineer. His field of specialization is Thermal Sciences with emphasis on the thermal management of conventional as well as high technology engineering systems. His current research activities in this field involve investigations related to thermal control of very large-scale integrated microelectronics. Furthermore, under a NASA Research Grant, he is currently studying transient performance characteristics of a capillary pumped loop thermal control system to be used in NASA's Space Station.

The revival of the U.S. space program with the recent successful flight of the space shuttle, Discovery, has produced growing activity in Washington related to the space station. GW's Professor Ali M. Kiper of the CMEE department is involved with the thermal management system of the space station project in cooperation with NASA.

The shuttles are taking different parts of the space station in each flight, and its construction should be completed in the mid-1990s. In structures like manned space stations, power consumptions are much larger than that of a spacecraft. One problem is the removal of dissipated heat from the electronic equipment, as well as cooling and heating the environment for those who live in space stations. The only type of energy removal process in space will be radiation, since conduction cannot be utilized. So, NASA needs a system that takes the wasted heat to radiators and disposes of it into space. The earthbound theories are to some extent applicable within the spacecraft, but has to be modified.

The energy will be removed from different parts of the space station and will be transported to the radiators to be rejected into space. In such applications, the conventional type of thermal management systems does not work. Either the systems used in the earthbound applications are very bulky, or from the reliability point of view, have some disadvantages.So, NASA is now considering the type of system where the working substance undergoes two-phase flow. The evaporation and condensation type of two-phase flow turns out to be very effective.

Mechanical parts in the space

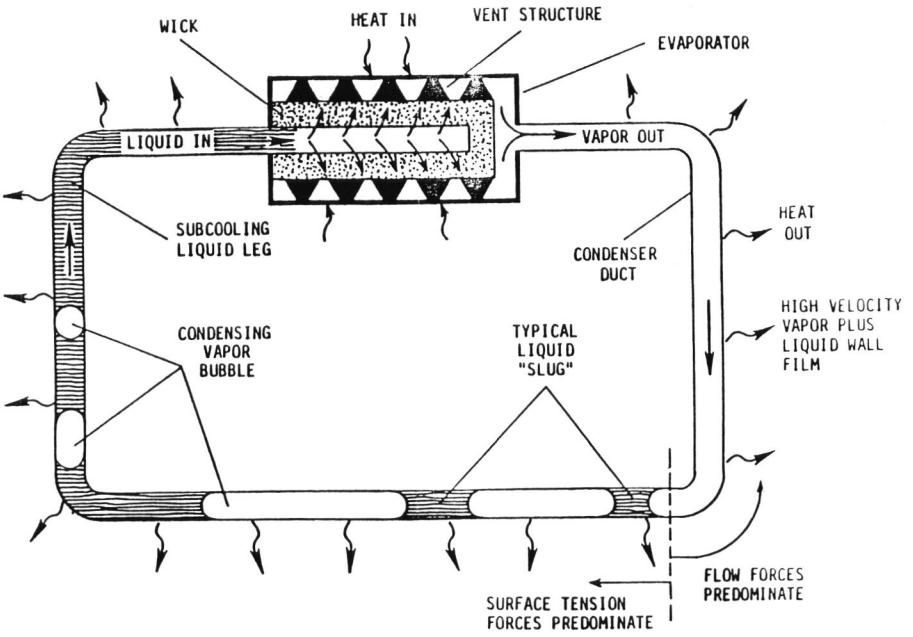
station system are heavy, and fixing them in space when non-operational is not easy. So, NASA prefers the type of systems which can circulate the working substance by capillary force. The Goddard Space Center developed a so-called capillary pumped loop system. In the simplest form, there is a liquid side and a special type of evaporator. The liquid is brought into the evaporator by capillary action and then is evaporated. Because of the capillary action, there is a pressure difference between liquid and vapor sides. The vapor is pumped to the condenser part by capillary action. Another liquid would remove the heat and transport it to the radiators. As a result, there are no mechanical parts. With the high technology capillary systems, it is possible to maintain an acceptable pressure difference.

NASA has a number of systems, one of them being CPL. In NASA, they developed a prototype and tested it in the earthbound system successfully. Small models have been tested with good results, but the mission is to develop a system to fit into the big project, the Space Station. Professor Kiper and his colleagues just received a contract from NASA to study the fundamentals of transient characteristics of the CPL system. This is one area of concern in the field of two-phase flow in microgravity environments, as it is applied to the space station.

Under microgravity environments, the tests are very expensive. Thus, drop towers which contain no gravity are used. A heat transfer system is made and dropped from the tower. Then, data is collected during a short interval.

Energy Resources for the Space Station

The proposed power capacity of the space station is 75 kW, which would be mainly generated by solar cells. Some nuclear power is also involved. Starting next year, NASA is launching a number of



Capillary Pumped Loop

spacecrafts. In October, "Galileo" will be launched to Jupiter, and then Magellan will be launched to Venus. The Space Telescope should be in orbit soon. In all these projects, the power component will be important, but compared to the space station, it will be in a smaller scale.

New CMEE Aeronautics/ Astronautics Program

This semester, a Masters Degree program in Aeronautics and Astronautics was initiated. The CMEE department already has a full-fledged Doctoral program in NASA/Langley. Many applications from graduates of very well-known universities, like MIT and CalTech, have already been received, and there seems to be an increasing interest in the program. With Goddard Space Center, NASA headquarters, and a space station center in the area, there is a growing interest in aerospace applications.

Other Research Activities

With the development of faster and denser electronic equipment, removal of wasted heat from the system is becoming more and more critical. Air cooling will be more than enough for conventional electronic systems. However, for much higher density electronic systems, liquid cooling or even two-phase cooling, in which dielectric fluid will evaporate and condense, must be used. If a cold liquid can be introduced through very small orifices, the jet action heat removal would be much higher in performance compared to the ordinary type of liquid flow. The methods, which can be used for the high-speed microelectronic systems, are currently being investigated. Eventually, the overall mechanical packaging of the electronic systems will be of interest, in which the constraints of the cooling problem will require consideration.

"In order to study a certain phenomenon, one needs a specific type of system. One has to maintain certain conditions, and only then can meaningful test data be obtained. So, bringing the system to that stage is the biggest challenge, and every research work involves going through this stage. Each problem that one tackles and solves gives great satisfaction."

Project Pathfinder Guides America Back to the Forefront of Space Exploration

by Jeff Dion and Glen Popick

When the Soviets launched Sputnik in 1957, it opened up space as a new obtainable frontier. The leader in this frontier would also be recognized as a leader in science and technology all over the world. The United States took over this position of prominence as the forerunner in space technology with the landing of Neil Armstrong on the moon on July 20, 1969. The United States had maintained this position until the mid 80's. Then, a major setback took place . . . the Challenger explosion. In order to regain U.S. supremacy in space, we need to undertake a broad-based program of space exploration, such as "Project Pathfinder." This project is centered around the development of four distinct areas of technology:
(1) space transfer vehicles,
(2) exploratory technology,
(3) operations in space, and
(4) humans in space.

Space transfer vehicles used to transport humans, building materials and supplies, should be developed first. Because we must keep on schedule with payloads, we cannot limit ourselves to only one launch vehicle as we did with the space shuttle and risk the chance of losing our launch capabilities. The primary goal of these new launch vehicles is to obtain a low cost-to-launch ratio in order to increase the number of launches. This will definitely allow space travel to become a routine event. Currently, the Soviets launch two vehicles a week compared to our five to ten a year. The most vital improvements that must be made in vehicles themselves are reliability, efficient maintenance, high-speed, and fuel efficiency.

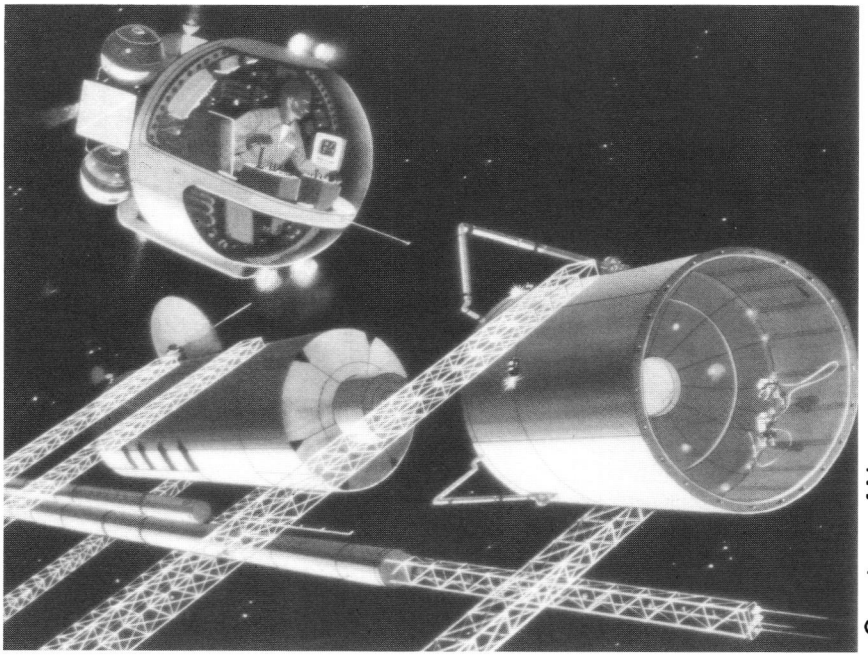
For exploratory purposes, we need to develop a means of landing on the surface of different planets, and of exploring them with land rovers in order to acquire, analyze, and return samples. By exploring different planets, we will learn more about our own planet, and how we can preserve it. For example, by examining the runaway green-house effect on Venus, we can prevent the same from happening on earth.

After initial exploratory work has been completed, the next step is to establish permanent operations in space, such as an orbiting space station, and a moon colony.Fundamental to the survival of a permanent base in space is the need for the development of a source of energy that can be utilized in the vastness of space. This should be the number one concern, whether it be nuclear, solar, or by harnessing the solar wind. Space docking, refueling and in-space assembly will further enable us to accomplish the goal of further space exploration.

The final result of "Project Pathfinder" is to fully integrate humans into space activities. To augment existing technologies, the primary need is the development of a high performance, long- duration extra-vehicular activity suit. Hand-in-hand with this suit, we must also research the effects of reduced gravity and its confinement on humans over long periods of time.

The technologies developed under "Project Pathfinder" will support a broad base of new exploratory missions. Three of the most feasible missions include a space station in orbit, a lunar colony, and a detailed exploration and understanding of the planet, Mars. The space station is currently on the drawing boards, and with proper Congressional support will be fully functional by 1996. Once the space station is fully operational, our next step will be to develop a lunar base. This would serve as a proving ground for low gravity construction and power generation. We will also be able to ascertain the effect of low gravity on humans. Finally, the moon would serve as a jumping off point for Mars and the other planets of the solar system. We in America must unite to support this common goal of exploring our Universe - our new Frontier. We should also be willing to work with the other space-faring nations of the world to foster international cooperation to attain one goal - the betterment of mankind.

— Jeff Dion and Glen Popick



Courtesy of Nasa

TECH BRIEFS

Main Street: EFT

The Main Street Electronic Funds Transfer Association (EFTA) exposition held in the nation's capital demonstrated EFT products and services in a simulated shopping environment. The general public was invited to the EFT exclusive Shopper Street to see some first-hand reactions to debit and smart card usage at the retail point of sale. A tour to an EFT EXPO exclusive Shopper Street adjoining the Exhibit Hall lasted nearly an hour, demonstrating hundreds of new products and services by companies, such as the AT&T, IBM, GTE, J. C. Penney, Unisys, and McDonnel Douglas. The EFTA EXPO featured a variety of major EFT topics, such as maintaining credit card growth, while launching debit cards and retailers as promoters of EFT.

EFT does not come fault-free. For instance, tremendous costs are involved in order to integrate the system hardware, software and network in practice. There is also a potential threat of variable security. As an added drawback, the customers and employees must have a comprehensive education and training. Furthermore, the future world of EFT imposes potential threat to the jobs of thousands of employees across the country. It has been predicted that EFT will be readily used around the world. However, the question remains whether the world will be ready for EFT.

Special thanks should be extended to the Electronics Funds Transfer Association for presenting over 200 exhibits, featuring the latest EFT technologies and for bringing the most impressive industry leaders to a perfect setting, in the heart of our nation's capital. So, as I look into the future of EFT, I look to a familiar face of technological confusion. Undoubtedly, most of the EFT products and services will be commonly used within the next decade.

— by Nadeem P. Malik

ATF - Revolutionizing Air-to-Air Combat

With a new decade approaching, developmental efforts have started to produce the next generation of fighter aircrafts. The Air Force's projected air superiority fighter, the Advanced Tactical Fighter (ATF), will be Air Force's first new fighter program in more than a decade. This fighter program will be the ultimate test for aircraft designers and engineers. Extensive work will need to take place in order to develop the new technologies, necessary to make this fighter stealth appearing, low-observational, lethal, and have the ability to fight around the clock. The goal is to produce a plane that will be twice as good in every aspect as the world's top gun, the Air Force's F-15 eagle.

The hope of producing such an aircraft rests on the shoulders of the two contract winners, Northrop teamed with McDonnell Douglas, and Lockheed teamed with General Dynamics and Boeing. They are both competing for the final contract, by building full-scale prototypes, which are due in the mid-1990's. As of right now, both teams are working from $691 million contracts to develop an aircraft that will cost no more than $30 million a copy.

The Air Force has envisioned a plane that is hard to observe, very reliable, easy to maintain, and most importantly the ATF cannot exceed 50,000 pounds. With this in mind, progress is being made in the use of weight-saving composite materials, reliable fiber optics, and digital computing flight controls. The most pursued technology is the advanced low-observables technologies, utilizing radar-absorbing composite materials, which would make the aircraft virtually undetectable by enemy radar. The wings that are being experimented with are called Mission Adaptive wings. The concept behind these smooth variable-camber wings, is that they will change shape by means of internal devices to sustain peak aerodynamic efficiency. These wings will improve the range and maneuverability of the aircraft, and would be just comparable to bird wings which adapt to flight.

The real challenge for engineers producing the ATF is developing avionics that are reliable and fast enough to operate and control this plane safely. Researchers believe that faster computers will be needed to operate the aircraft, especially for night flying. The Air Force believes that the avionics and flight controls of the ATF will give it an extraordinary advantage in air-to-air combat. The ATF is envisioned as being able to shoot down enemy planes at a rate of ten for every one lost.

The engines that will be used in the ATF have already been tested, and seems to be the engines that the ATF will use. The amount of thrust produced by the engines will far outweigh the weight of the plane, which will give the ATF the capability to cruise supersonically over long distances without the use of afterburners. This is an

Continued on page 32

NASA and GW Unite with JIAFS

The George Washington University in search of an opportunity to expose a select group of its engineering professors and graduate students to the realities of private industry, approached NASA with a novel idea. This idea was to establish a research center owned by NASA and operated by a host of NASA and GWU personnel. Such a venture promised much to both sides. For NASA, this venture promised the opportunity to conduct research of national importance with a group of highly-motivated scientists provided by the university. NASA would also be provided a labor pool of highly- trained graduate students in fields that NASA needed. GW professors who work at the facility gain experience with the needs and demands of private industry, and increase GW's reputation in the engineering community. Thus, GW and the Langley Research Center combined to form the Joint Institute for Advancement of Flight Sciences (JIAFS).

Now in its eighteenth year, JIAFS has granted 205 graduate students the opportunity to work with its advanced facilities. In addition to valuable experience, graduate students also receive scholarships for their graduate degrees, which they work on at the Langley facility along with their research project. The program is quite selective, only those graduate students who are both extremely talented and motivated may participate. On the average, about 35 graduate students out of thousands of applicants are chosen from around the country to participate in the program.

Among the projects researched at the facility are problems concerning aeronautics and astronautics. Jet noise reduction is one of the major areas currently under study. Other topics under study involve jet fighter maneuverability at high angles of attack and the feasability of lunar and planetary transports.

JIAFS is a unique institution, combining the strength of academia with industry to achieve a mutually beneficial situation. Though the program only involves a relatively small number of GW's engineering students and professors, the benefits it provides both the science community and the graduate students make it a very worthwhile program, and a starting point from which similar programs will grow.

— by Kerry Long

Association for Computing Machinery

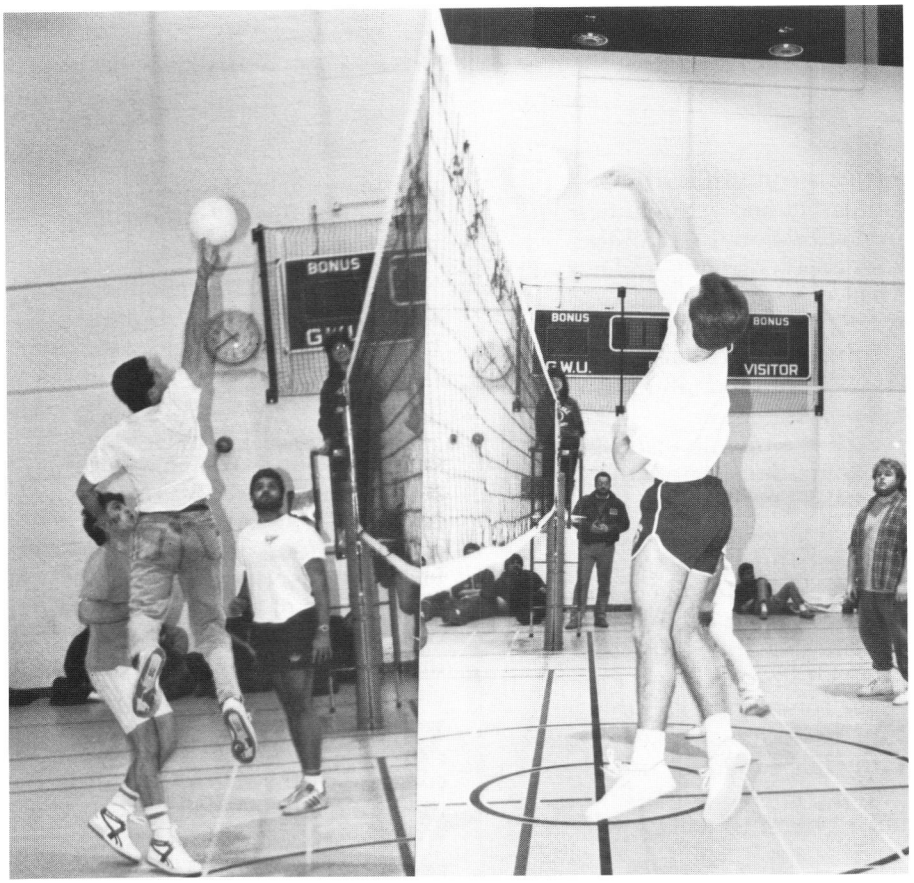
As of March 1989, a new organization was officially recognized as the George Washington University student chapter of the Association for Computing Machinery (ACM). ACM's activities organized by the society members started Fall semester of 1988. The ACM is an organization with special interests in advocating the advancement of the science and technology of information processing, developing and improving curriculum for colleges, holding conference for the purpose of research, and promoting and providing the means of a continuous flow of information processing to the public.

The GWU student chapter is under the guidance of Professor Epstein, who is a member of ACM. Currently, thirteen members are enrolled in ACM/GWU. Although the majority is composed of computer science majors, membership is not restricted to individuals with engineering or applied science backgrounds, nor is it restricted to members of the GW community. In fact, anyone interested in computers and/or computer science is warmly welcomed, since the field of computer science is indeed, not confined to any specialized area of thought or knowledge.

A variety of activities are organized by the ACM, ranging from sponsoring events in career planning to social events, aiming to promote a tighter bond between the diverse GW community. Lecture sessions are also held, where guest speakers are invited to discuss topics of interest to the members, and are able to pursue further information regarding subjects unrelated to their field of study.

As with all student organizations, the fate of ACM lies in the hands of its members and their abilities to organize, direct and pursue the objectives of the society, as well as their capability to expand while refining their horizons. ACM is indeed, a new chapter in GWU, but as Professor Epstein expressed, a positive response from the GW community would enable the ACM to develop into a fully-functional student organized chapter. Anyone interested in joining ACM/GWU can contact Professor Epstein at (202) 994-6471. the membership fee is only $5.00.

— Delina Merican



Courtesy of Mohab Akhnoukh

Let's Play Volley Ball!!!

Following tradition, the annual Engineers' Week Volley Ball tournament turned out to be a success, bringing Engineers of various studies together for a night of comaradery and fun. In all, there were five teams, each consisting of six or more players that participated in the tournament. However, **unlike** past tournaments, this year's also attracted a number of spectators, namely Theta Tau members who came to cheer on their team; thus, showing an ever growing unity among the Engineering student body.

This year's teams, unlike previous years, were widely mixed in form of nationality, Class status, and varying majors; hence, giving a sense of fellowship among Engineering students as a whole. The participating teams were AD-HOC, Plain Waves, Theta Tau one and two and Theta Tau pledge class.

The games were held at the Smith Center Auxiliary gymnasium on February 28 from 9:00 p.m. to 11:30 p.m.The tournament was held in a round-robin fashion using double elimination procedure.

After a night of hard playing the tournament came down to two teams . . . the Plain Waves with no losses and Theta Tau 1 with one loss to its pledge class. This was the final match to see who would get the spoils. After two long grueling games it came to a hault with Theta Tau 1 as the only ones left standing.

Surely, Theta Tau were the winners, but there were certainly no losers that evening. Everyone who participated came out a winner, gaining a sense of accomplishment and friendship. This of course enhances a feeling of school spirit in the GWU Engineering community.

— Eric Takamura

WHAT'S ALL THE 'EGGS'ITEMENT ABOUT?

George Washington University's engineering students gathered at Tompkins Hall of Engineering to watch their projects plunge to destruction. The event was the Engineers' Council and American Society of Mechanical Engineers (ASME) annual Egg Drop contest. The purpose of the contest was to allow students to implement their education by performing the seemingly impossible feat of dropping a raw egg from five stories and preventing it from landing 'sunny side up'.

The student's objective was to design a vehicle for the egg that would combine the speed, weight, and accuracy necessary to minimize the Win Factor Equation. According to Scott Wofsy, the coordinator of the event, the bottom line was not to make "egg drop" soup!

These eggs were not just served on a plate with bacon, they were garnished in a variety of aerodynamic, pressure-resistant containers that even NASA could eat for breakfast. Packed in everything from tomatoes to marshmallows, these "egg"ronauts met their destiny before a cheering crowd and the local news.

EULER UY

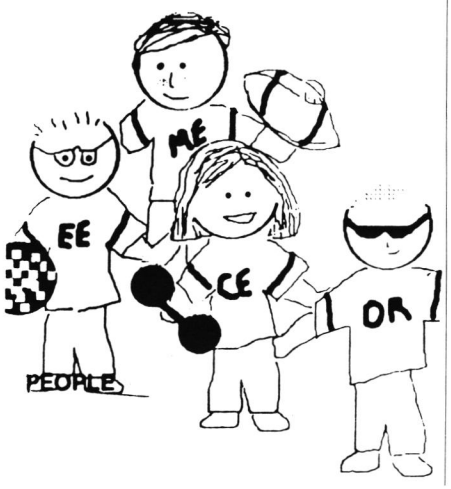
The all-time crowd pleaser was unanimously the Tupperware/Twinkie combination. This concoction proved runny however, to the invincible rocket ship design. Mario Pachjou won the competition by laying his golden egg inside his interpretation of the rocket; a plastic Evian water bottle packed with styrofoam. Despite the academic elements and intense competition behind this contest, the crowd thought that it was one big yolk!!!

—Steve Goldsmith

CORRECTION:

In the Fall semester '88 edition of MECHELECIV the article entiled "Computer 'Virus' Epidemic Strikes Terror in GWU" by Nadeem P. Malik was mistakenly typed to say "Then, turn the power back on of the infected operating system . . . " It should read "Then, turn the power back on (reboot) on a uninfected operating system . . . " We appologize for this gross error and hope it will rectify any such mishaps.

— MECHELECIV STAFF



Courtesy of Mohab Akhnoukh

Bridge Contest

The Popsicle Stick Bridge Contest, an annual event for Engineers' Week was held on March 2nd commencing at noon and lasting for a little over two hours. The guidelines for the contest were as follows:

1. Max Wgt. 200 grams & Min Hgt. 4" in.
2. Max Length 24 - 26 in.
3. Min Width 4" in.
4. Must consist of two layers: a top and a bottom.

However, some questions arose, just as they had last year, on the ambiguity of the guidelines. These questions concerned deflection, internal passing space, and procedures and factors for disqualification.

There were twenty official entries compared to last year's twenty-five entries, revealing a continued interest by the students. In addition to the participants, the competition attracted a crowd of thirty or more spectators. The unusual aspect about this year's competition was the overwhelming number of Electrical Engineers, EE, who entered.

The winning bridge of the day was designed by Mohammad Radzi Nor, a Civil Engineering student. His bridge held two hundred and twenty-five pounds until failure occurred.The second strongest bridge holding two hundred pounds was designed by Glen Popick and Nelson Kee who are both EE majors. The third place bridge was built by Reza Vassetizadeh, a CE major, holding one hundred and twenty pounds. Reza had built another bridge that held two hundred and ten pounds, but it was disqualified after a dispute of being point one (1/10 in) of an inch short. Rosliza Roslee (with an accent on 1st. e) and Yarlida Yahya, last year's first place winners, also entered again this year. Their bridge, however, was disqualified for being thirty-eight (38) grams over the maximum weight limit. The prizes were $100 for first place, $60 for second and $40 for third place, respectively. On the average the holding load seemed to be about eighty-five pounds.

In all, besides some discussion over the ambiguity of the rules set forth by the Engineers' Council, the contest turned out to be a great success and a lot of fun.

— Eric Takamura

THE EE/CS DEPARTMENT GETS INVOLVED IN ENGINEERS' WEEK

Two new events were included in this year's Engineers' Week for the EE/CS department, co-sponsored by the Institute of Electrical and Electronics Engineers (IEEE) and the Eta Kappa Nu Association (the Electrical Engineering and Computer Engineering Honor Society). They were the Brain Teaser Contest and the Pascal Programming Contest.

BRAIN TEASER

This contest consisted of 7 mind boggling questions in the fields of engineering and mathematics. It was distributed on February 27 in the Davis-Hodgkins House to anyone who wished to participate. They had one week to answer as many questions as they could. The answers were collected on March 3rd. The winners were Danial Horne with a 1st Place cash prize of $50.00 and Patrick Wamsley with a 2nd Place cash prize of $30.00. Danial answered five out of seven questions correctly, and Patrick answered three out of seven correctly. The questions and answers in this year's Brain Teaser are as follows. Hope you'll be ready to get involved next year !!!

Problem #1:

"How's our Committee for the Preservation of Aging Brain Tickler Judges coming along?" asked Jim.

"Not too well," replied his faithful sidekick, Judy. "I've contacted the eight people you recommended, but it's a tricky situation."

"What's the problem?"

"Well, Fred won't join at all if we invite both Adam and Doug; he won't agree to serve with Carol, unless we ask Eve; and Fred won't join if we exclude both Bill and Gail. Gail will join only if we ask Carol, but Carol refuses to sit on any committee which includes Adam. Moreover, if we want both Bill and Carol, we will need to include Howard; and if we want both Bill and Howard, we will need to include Eve. Eve, however, will not accept Adam or Doug and draws the line at what she calls the poisonous combination of Carol and Gail. Howard refuses to serve, unless Fred also serves."

"Engineers!" exclaimed Jim. "Suppose we settle for a committee of four?"

"Yes, I've managed to work one out. Here are the names. Which one do you want to be chairperson?"

"None of them is satisfactory. We'll have to add a fifth person."

This they did successfully. Who are the members on the committee, and who is the chairperson?

A. The committee consists of Bill, Carol, Eve, Fred, and Howard, with Carol being the chairperson. Based on the given information, it relatively easy to show that if Adam is on the committee, then no committee of five can be formed (Expressing the given data and symbolic logic format is very helpful.). It can also be shown that Gail and Doug have to be excluded to form a committe of five. Of the five people left, only Carol can be removed and leave a compatible committee of four. Therefore, Bill, Eve, Fred, and Howard must have been Judy's original committe of four, and Carol was added as chairperson.

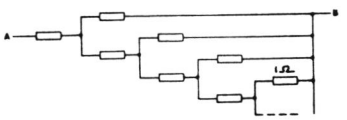
Problem #2:

If i, j, and k are non-zero, finite integers, find all solutions, excluding permutations, of:

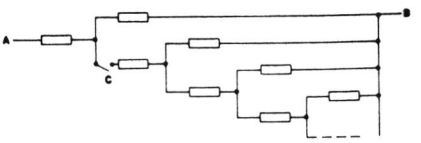
arctan i + arctan j + arctan k = 180 degrees

A. The possible values for i, j, and k are 1, 2, and 3 (or -1, -2, and -3) in any order. Let arctan i = alpha, arctan j = beta, and arctan k = sigma. Then, alpha + beta + sigma = 180 degrees, or alpha + beta = 180 degrees - sigma. Therefore,
tan (alpha + beta) = tan (180 degrees - sigma), or
(tan(alpha) + tan(beta))/1-(tan(alpha) * tan(beta)) = -tan(sigma)

Problem #3:



If each resistor is one ohm, what is the resistance between A and B in this infinite network?



A. If the switch at C is open, the resistance between C and B is R, the same as the resistance between A and B when the switch is closed. So, R = 1 + (R/(1+R)), and R = 1.618 ohms.

Problem #4:

Consider the number A = 8888^{8888} Suppose we were to write this number in decimal form. Let B equal the sum of the decimal digits of A; i.e., B is the result of adding together all of the digits of A. Then, let C equal the sum of the decimal digits of B, and let D equal the sum of the decimal digits of C. What is the value of D?

A. D = 7. Before the days of hand-held calculators, schools used to teach a procedure for checking arithmetic problems called casting-out-nines. This procedure is based on the fact that if all the digits of a number are added together (excluding, i.e., casting-out, any 9's) to form a new number, then the two numbers are congruent modulo 9. Applying this to the current problem gives: A = 8888^{8888} = B = C = D (mod 9).
Also some congruence manipulations are necessary:
8888 = 5 (mod 9)
8888^{3} = 125 = -1 (mod 9)
8888^{6} = 1 (mod 9)

$8888^{8886} = 1 \pmod 9$
$8888^{8888} = 25 = 7 \pmod 9$
Thus, $D = 7 \pmod 9$.

Problem #5:

An infinite array begins with the following numbers. Each is the smallest non-negative integer that does not appear to its left in the same row or above it in the same column. Find the non-recursive formula for the number in row R and column C.

0	1	2	3	4	5	6	7
1	0	3	2	5	4	7	6
2	3	0	1	6	7	4	5
3	2	1	0	7	6	5	4
4	5	6	7	0	1	2	3

A. The number in row R and column C is equal to XOR (R, C), where XOR is the bit-by-bit exclusive-OR of R and C, expressed as binary numbers, with row and column counting starting with 0. With exclusive-OR, if the two bits are the same, the value is 0; if they are different, the value is 1. For example, the value in row 3, column 5 is XOR (011, 101) = 110 = 6.

Problem #6:

English fairs of old had a game of skill involving five identical thin circular plates and a larger circle painted on a table. A gamester would wager that he could place the plates one by one in an overlapping fashion to cover the circle completely. Once placed, a plate could not be moved. The game was profitable for the operator. For a circle of unit radius, what is the smallest plate radius that will suffice? Express the answer to at least four significant figures, and provide a sketch of the arrangement.

A. Radius of 0.60938.

Problem #7:

The other day as I was waiting for the elevator in my office building, I ran into an athletic friend of mine. "I always take the stairs," he said. "Good exercise. Something less than a thousand steps, you know. The strange thing is that if I take the stairs 2 at a time, there is 1 step left at the end; if I go up 3 at a time, there are 2 steps left; if I go up 4 at a time, 3 steps left; 5 at a time, 4 are left; 6 at a time, 5 are left." As he went bounding away, it occurred to me (since I knew how many stairs there were) that if he could go up 7 steps at a time, 6 would be left; and if he could go up 8 steps at a time, 7 would be left. How many stairs does he normally climb?

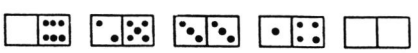
A. 839 stairs. The following congruences must be satisfied:
$S = -1 \pmod 2$
$S = -1 \pmod 3$
$S = -1 \pmod 4$
$S = -1 \pmod 5$
$S = -1 \pmod 6$
$S = -1 \pmod 7$
$S = -1 \pmod 8$
The common solution to these congruences is $S = L - 1$, where L is the lease common multiple of 2, 3, 4, 5, 6, 7, and 8. Therefore, $L = 840$ and $S = 839$, which is the only solution for S 1000.

PASCAL PROGRAMMING CONTEST

This contest consisted of a programming problem that was provided by Professor Rachelle S. Heller of the EE/CS department. It was held from 1 to 6 pm on March 3rd in Tompkins Room 306. The only two rules of the contest were that the participants write the program in PASCAL and that the program be completed to working condition in as little time as possible. As with the Brain Teaser, there was one 1st Place winner and one 2nd Place winner. Khalid M. Al-Akhras won $80.00 for 1st Place, and Bob DeRosa won $40.00 for 2nd Place.

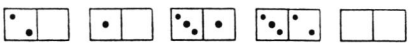
The programming problem for this year was Domino Solitaire, and is as follows:

The game of dominoes is played with a set of 28 rectangular tiles that look like:

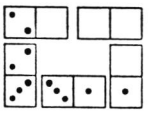


each half being marked with from zero to six spots, and each combination from double zero to double six, occurring exactly once. In playing the game, chains of dominoes are constructed so that abutting halves have the same number of spots. The competitive side of the game for two or more players will not be considered. Rather, we consider a one-person domino game, Domino Solitaire, the rules of which follow.

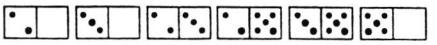
Given a hand of from four to twenty-eight dominoes, arrange them in a circuit (closed path) such that abutting halves have the same number of spots. If such is not possible, determine that it is not possible. Every domino in the hand must be used. For example, given the five dominoes:



A possible circuit is:



whereas the collection:



cannot be placed to form a circuit.

Write a computer program to play domino solitaire. Input to the program should be a subset of from 4 to 28 dominoes, entered by the user from the keyboard. Output should be the statement that no circuit is possible for this subset, or a statement that a circuit is found, followed by a list of the dominoes in the order that they appear when traversing a circuit in a clockwise direction. Each domino shall be represented as two integers with each integer corresponding to the number of spots on one-half of the domino. The user shall type the pair of integers -1 -1 at the end of the list of integer pairs, representing the dominoes to indicate that there are no more dominoes to be entered. On output, if a circuit can be found, the two numbers representing a domino should be written in the order in which they are encountered during a clockwise traversal of the circuit.

For example, the input corresponding to the example above, could be:

2 0 1 0 3 1 3 2 0 0 -1 -1

for which the output below is correct:

circuit is found
2 0
0 0
0 1
1 3
3 2

while the output below is incorrect:

circuit is found
0 2
0 0
0 1
1 3
3 2

These two new annual additions for the EE/CS department will definitely offer the participants of upcoming Engineers' Weeks a "Brain Teasing" challenge of the minds!!! Be sure to enter next year !!!

— by Swati Patel

□□□□□□□□□□

ENGINEERS' WEEK '89
FEB. 27 - MAR. 4
Schedule of Events

Day/Date	Time	Event
Monday Feb. 27	11:30am-1:30pm	Lecture: "Engineering and the Environment"
	3:30pm-6:30pm	Student/Faculty Reception
Tuesday Feb. 28	11:30am-1:30pm	Lecture: " Superfund "
	9:00pm-11:00pm	Volleyball Tournament
Wednesday Mar. 1	2:30pm-3:30pm	Lecture: "How to write a resume"
Thursday Mar. 2	12:00pm	Popsicle Stick Bridge Contest*
Friday Mar. 3	1:00pm	Egg Drop Contest*
	1:00pm-6:00pm	Computer Programming Contest*
	4:00pm	EC logo Contest* (Winner selection)
Saturday Mar. 4	7:30pm-1:00am	Engineers' Ball**

ENGINEERS' BALL - Another Successful Ending

This year's Engineers' Ball held on March 4th proved once again to be a success and a memorable ending for Engineers' Week 1989. Let me briefly recap on the evenings festivities . . .

Dressed in their formal attire, GWU students, faculty, staff, and their guests began to arrive at the Washington Marriott Hotel around 7:30 pm. As the participants waited in line to present their tickets for the Ball, they were also in anticipation of sharing exchanges with good company, of dining on delicious cuisine, and of dancing to the musical beat of a new sensation, called "Highway Star"!

Their patience was not in vain, for they were at once received by the beautiful Marriott Ballroom that was exquisitely decorated with meticulously-placed table settings and romantic, dimly-lit chandeliers.

The formal proceedings began at 8:00 with opening remarks from Tariq Al-Fadl, the Engineers' Council President, and Mohammed Al-Fakhri, the Master of Ceremony for the evening. Next the guest speaker, John David Morris, the newly-elect President of GWUSA, delivered a meaningful and well-received speech on his new vision of "bridging the gap between the School of Engineering and the rest of the University . . . "

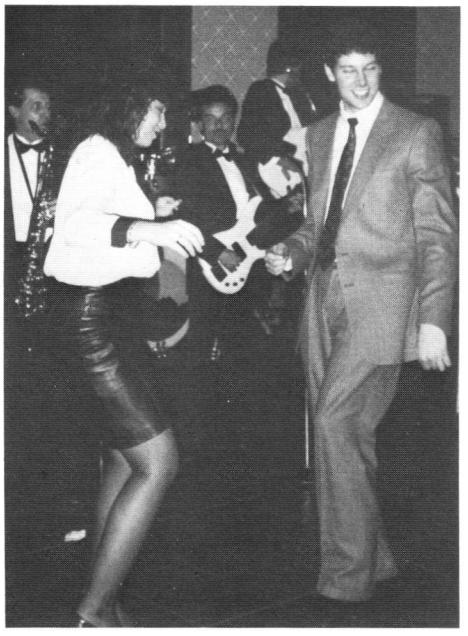
Following the formalities, the guests enjoyed their choice of chicken, beef or fish entres. Salads, rolls, and various vegetable side dishes complimented each entre. Then to top it all off, a big piece of delicious chocolate cake was served as dessert. It should be noted that for the last two years, the Engineers' Council has made a determined effort to serve tastier food and to accomadate the different tastes of the guests.

Immediately before the serving of dessert, Engineering sweatshirts and cash prizes (paid for by the Engineers' Council) were awarded by Tariq Al-Fadl and Zuhdi Jaouni, President and Vice-President of the Engineers' Council, respectively, to the winners of the events held earlier during Engineers' Week. These events were the annual Popsicle Stick Bridge Contest, the Egg Drop Contest, and the Volleyball Tournament. The winners of the three new events this year, the Logo Contest, the EE/CS Pascal Programming Contest and the Brain Teaser, were also awarded cash prizes. Finally, door prizes were awarded to three lucky students whose names were drawn by chance.

After dessert, the vibrant melodies of "Highway Star" beckoned people onto the dance floor. The swaying rhythm of their brass section and the alluring deep voice of their lead singer kept the crowded mob of dancers on the small dance floor until 12:00 PM. The crowd included even a few faculty members, who seemed to be dancing up a storm, and who could easily put others to shame! After the Ball had ended, everyone left the warmth of the Marriott with smiles on their faces and thoughts of how entertaining the evening was.

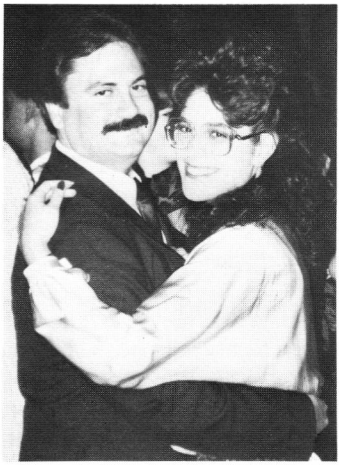
When talking with people after the Ball, the unanimous vote was that this year's Ball most definitely outdid last year's in terms of entertainment. The band was exceptionally chosen, and was truly the hit of the evening. However, many people agreed that the Ball was not well-publicized and for that reason, not enough faculty members attended. However, for those who were there, the entire evening was quite a success. This success is of course attributed to the Engineers' Council and their hard work. The committee responsible for putting together this year's Ball was Javid Sonde, Zuhdi Jaouni, Tariq Al-Fadl, Qusay Al-Shatti, and Rose Province. They made this year's Engineers' Ball a true triumph and a perfect ending for an even more memorable Engineers' Week!!!

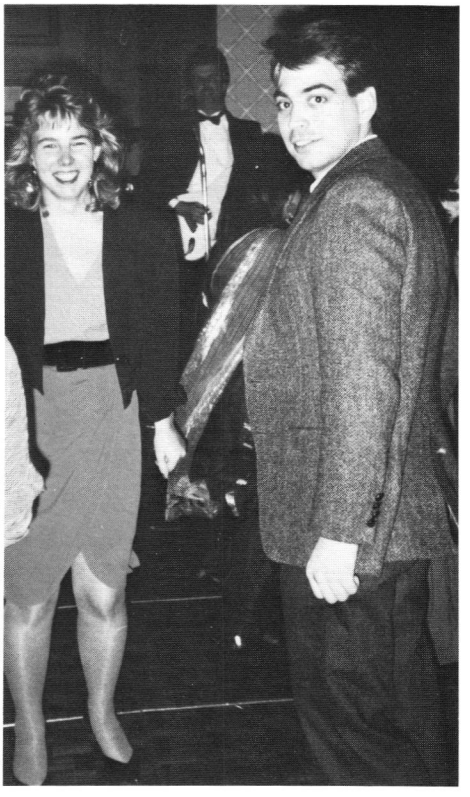
—by Swati Patel



REFLECTIONS FROM...

ENGINEERS' BALL





GW Apprentice Programs Give High School Students a Head Start in Their Career

There are many exciting programs sponsored by George Washington University of which we, as undergraduate or graduate students are unaware of. One is the Summer Science and Engineering Apprentice Program (SEAP), an amazing program nurtured and developed by Marylin Krupsaw, the program director. The program takes intelligent highly-motivated high school students and gives them "real life" laboratory experience in 22 Department of Defense laboratories, such as the U.S. Naval Acadamy, Harry Diamond Laboratories, Naval Medical Research Institute, and the Naval Research Laboratory. This experience greatly stimulates students' interests in science and engineering, and permits a student to explore career possibilities firsthand. It also turns out to be a great recruiting tool for these laboratories. A research facility can almost "grow its own" future scientist or engineer.

The program is an outgrowth of one started by the National Science Foundation (NSF). When the NSF funds ran dry, the Naval Research Laboratory gave its own grant to the University of the District of Columbia (UDC) to continue this program with only 28 students. But UDC was interested in keeping the program local, while Krupsaw had other ideas. So the program moved to GWU where it was expanded with the help of a very supportive administration, to include almost 700 students.

Students from all area high schools submit an application which includes a short essay and teacher recommendation. The director personally meets with scientists in the participating laboratories who volunteer to be "mentors". The mentor describes a project and the student qualifications needed for success. The mentor then interviews a number of applicants to be sure that both will be satisfied with the arrangement.

The Department of Defense gives a grant that includes an educational support stipend (at least $1100.00) for each student for the eight weeks. GW handles all the recruiting, placement and follow-up for the program.

During the eight summer weeks, "brown bag" seminars are held to permit students to hear speakers on their lunch break. Students learn much during lunch as in the laboratory, since they also have the opportunity to take ITV courses or video tutorials. These classes put SEAP participants way ahead when they go back to school in the fall.

At the end of the eight weeks, students are required to write a paper on their summer research experience. Out of town students stay at the GW dormitories and enjoy special events in Washington during the final week of the program, including a special Navy Congressmen on Capitol HIll, and special presentations at the Air and Space Museum. The final session starts at Lisner Auditorium to enjoy speakers, such as Dr. Edward Teller or RADM Richard Truly before they split into classrooms to present a short summary of their research results in seminar sessions.

The experience these students receive from the program is invaluable. Many students continue to COOP at the same laboratory after they begin their college careers. Because of their participation in SEAP they are able to begin a COOP program in their freshman year. One of the most exciting outcomes of this program is that students who started as high school apprentices, continued the affiliation during their academic careers and are back in the laboratory, serving as mentor for a new high school apprentice.

Krupsaw's enthusiasm for the program is strong, which is understandable considering all the young people who have been given the oppurtunity to become valuable, creative members of our technologically-oriented society through this program.I cannot help but be a little jealous of the lucky students who have been and will be involved in the program.

There are two other affiliated programs associated with the original grant. One is called Teaching New Technology (TNT), in which high school science and math teachers are provided with an update on research trends, and spend a summer in the same laboratories as the students, and Science, Technology and Research Students (STARS), which provides D.C. Public School junior high school students with an early awareness of science and technology. This is done through a concentrated three-day program involving classes and speakers in a retreat-like setting, which allows them to explore career options andopportunities in science and engineering.

— by Rose Province

Continued from page 24

impossible task in the current generation of fighters. The ATF will also be capable of reversing its thrust, which would give it short landing and takeoff capability.

The ATF program has been delayed, because of continually changing person requirements and increased developmental costs. The Air Force now hopes to start producing operational aircrafts by late 1997 or early 1998. Having an aircraft of this magnitude will give the United States a decisive edge in the race for air superiority.

— by Jeff Dion

CAMPUS NEWS

Theta Tau Revisited

The Theta Tau National Professional Engineering Fraternity has returned to the George Washington University campus. In the last MECHELECIV, we heard from Bobby Makheja, the president of Theta Xi, a local professional engineering fraternity. Since then, Theta Xi has become the George Washington University Colony of Theta Tau. This semester, they are petitioning to the National for reactivation as a chapter of Theta Tau. The prospects are bright: the colony has been active in the engineering school and has received the support of the faculty, administration, and students.

In 1934, Phi Theta Xi, a local professional fraternity, was installed as the Gamma Beta chapter of Theta Tau. An unfortunate turn of events lead to the chapter's deactivation in 1978 after forty-four years at GW. In 1988, Professor Douglas Jones, a Gamma Beta alumnus, gathered fourteen interested students and launched the effort to return Theta Tau to GW.

This semester has been a good sign for both Theta Tau and the engineering school. The number of interested students peaked at around twenty during rush. Eventually, a pledge class of thirteen was formed, more than three times the size of the fall pledge class. The pledges appear highly-motivated and should prove to be excellent additions to the fraternity.

Theta Tau has become quite active. During Engineers' Week, the colony organized two seminars entitled "Engineering" and "The Environment", which were very interesting and will, hopefully, increase students' awareness of growing environmental problems. Theta Tau was also responsible for the volleyball games, which approximately forty students attended. Theta Tau members took part in most of the other Engineers' Week activities with brothers winning the Egg Drop contest and the Logo Contest. Many members and pledges ran for positions in the Engineers' Council Elections. Although few Theta Tau's were elected, the Theta Tau council representative and president-elect Javid Sonde look forward to working together.

Theta Tau has taken many steps towards improving the engineering school and establishing a strong bond among engineers. The goals of Theta Tau are to unite its members in fraternal fellowship and to promote professionalism and excellence in engineering. Theta Tau is the only fraternity for engineers. The distinction from social fraternities is the professionalism, and the belief that engineers, united in their professional goals, will form a stronger fraternal bond. If you are looking for something more from the college experience than just simple academics, look to Theta Tau.

— by Chris Goldsmith

TECH BRIEF

Engineers Provide Reliability in Power Systems during Earthquakes

Southern California, known for its history of earthquakes, has become the focus of a study on power systems reliability during and after natural disasters. Experts focus more on earthquakes that other disasters, because of their unpredictable nature, and is exacerbated by its aftershocks.

Earthquakes can have varying effects on utility facilities, ranging from cutting power off to residents, loss of synchronization among operators, and leaking of oil in transformers that could lead to fires. In order to restore power to residents quickly, utility facilities reconfigure the system by circumventing the power flow about the damaged equipment. Yet, the resumption at normal power flow often takes months of repair.

Today, engineers are establishing ways for better design standards for earthquakes to predict their effects. They now employ the method of databasing. The data collected from earthquakes provide information on what can be expected from future earthquakes. This information, based on the characteristic paths that shock waves travel, helps predict the extent of the shaking at a particular site. Information can also be gained on the extent and type of damage to the system that can be expected. Based on this, future sites for power facilities can be designed to withstand the worst-case earthquake predicted to occur at a particular location. Yet, only empirical relationships can be used, since earth's geological behavior is in a nonlinear fashion.

Although new design criteria have been established by engineers, no changes have been taken at most facilities. This is primarily due to the concern over the cost-benefit equation, since most recent earthquakes have created less damage than expected. In addition, databasing predicts with higher accuracy a system's response to earthquakes and therefore, reduces the margin of safety, which until now many have been overestimated.

— by Cecile Silvestre

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